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AND

GENERAL SCIENCE.

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[OFFICIAL NOTICE.]

January Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, January 3, 1895.

The January meeting of the Society of Gas Lighting will be held in The Arena, No. 39 East 31st street, New York City, at 3 P.M. of the 10th inst.

FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

January Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, January 2, 1895.

The January meeting of the Guild of Gas Managers will be held at Young's Hotel, Boston, Mass., at noon, Saturday, the 12th inst.

A. K. QUINN, Secretary.

BRIEFLY TOLD.

DEATH OF MR. THOMAS C. CORNELL.—We regret to announce the death of Mr. Thomas C. Cornell, for many years President of the Yonkers (N. Y.) Gas Light Company, who departed this life on December 29th last. Deceased, who was in his 76th year, joined the American Gas Light Association, at the first annual meeting, held in Masonic Hall, this city, October, 1873, and was very prominent in the Association in the earlier years of its history. The funeral services were held in the Church of the Immaculate Conception, Yonkers, on the morning of the 2d inst. We have in preparation some account of his long and honorable connection with the gas industry.

OPINIONS OF GAS CONSUMERS RESPECTING A NAMED MUNICIPAL GAS PLANT.—In our item columns will be found something concerning the proposition, now under consideration by the authorities of Alexandria, Virginia, made by capitalists to lease the municipal gas plant of Alexandria for a term of 99 years. The proposition was submitted by a Philadelphia concern, which seeks to do business under the name of the Atlantic Gas Construction Company, and while we are not completely advised as to the terms that the would-be lessors offer the city, our correspondent nevertheless furnishes other matter bearing upon the negotiations that is altogether interesting, even if it is not statistical. In the first place, Alexandria itself is a handsome, staid old city, lazefully reposing on the Potomac river, only seven miles or so below Washington, and although it is an important point in the Richmond and Danville Railroad system, and also pays tribute to the Baltimore & Ohio, through the latter's Alexandria branch, it cannot be said to be much on the bustling order, despite the fact that its population at the present time is not less than 15,000. Perhaps its normal languor accounts for the fact that the annual gas sendout there is less than six millions cubic feet, yet it would be hard to account for such paucity on that ground alone, unless it be that Alexandria's people are prone to sleep for 16 hours out of the 24. Suppose we place it in contrast with the city of Danville, located on the south-central line of Virginia and North Carolina, which has a population of 12,000, and which also operates its own gas

works, for the purpose of tracing the fault in relation of gas sendout to population. In the first place, coal gas is made in both places, and the candle power of the product supplied is identical to all intents and purposes—17; but, in the second place, the average price per 1,000 charged is $1 in Danville, whereas in Alexandria the rate is $1.50. To be sure, this disparity will go a long way towards accounting for the difference in output; but it will not by any means explain it all away—for the exact differences to be reconciled are an output of 5 millions cubic feet per annum amongst 15,000 people, against an output of 20 millions amongst 12,000 people, with a difference of only 33⅓ per cent. in the selling price. Well, to come back to the words of our correspondent regarding the present agitation over leasing the Alexandria plant to private owners. Perhaps the opinions delivered by prominent residents anent the change will do more to solve the disparity noted above than were we to delve forever amongst figures and ratios and speculations in attempting to put the gas supply of Alexandria and Danville on equal rational planes. Our correspondent finds that Mr. King, a prominent merchant of the place, is emphatically in favor of leasing the works, so that the city will not be obliged to dip into its treasury for some $20,000 or $25,000, to be expended in replacing "rotten mains." Mr. King, however, offered other reflections on the gas management of the place, which latter go to show that he is of the type of chronic grumbler, in that he claims he was "robbed" some years ago through being overcharged for his gas service. He may have been "robbed," but all of his yawping in that direction is as ineffective in arraigning the gas management of Alexandria as his first charge is effective. "Rotten mains;" there is the difficulty, telling to the ear of every gas engineer that the former revenues of the gas works were diverted to other city benefits—perhaps to the bettering of the roadways, to the perfecting of the city's buildings, to the maintaining of its charities, or other, in general, good purpose—rather than to keeping up the physical condition of the works which made such revenues possible. Ex-Mayor Downham, who, from his former active connection with the management of the gas works ought to know whereof he speaks, advances his belief that the works ought to be put under private control, but curiously falls into the habit, too, of the chronic grumbler, by remarking that the lower the rate the higher the gas bill. He goes further and comes nearer to the mark, however, when he puts the matter on the basis of getting rid of the works "because of the condition of the street pipes." Other residents spoke out their belief as to the good policy of getting rid of the works, and amongst the number was Ald. Lindsey, who is active in the existing Finance Committee of the Board; but the King and Downham presentments are sufficient in our belief to show why Danville's gas supply and that of Alexandria are so far apart. To their charge of "rotten mains" we would add that of "rotten works" and "rotten management;" and until new and sound conditions regarding the three sources of rottenness prevail there, Alexandria will not only be as far, but farther behind Danville than is now the case. Possibly the favorers of the municipalistic idea will explain why that practice has proved so provocative of bad results in Alexandria; but whether they do so or not (and they will not), the fact remains that private enterprise stands ready to perform there that which public control has been signally unable to accomplish.

NOTES.—At the special election of the shareholders in the Cincinnati (O.) Gas Light and Coke Company, held on the 29th ult., for the purpose of voting on the proposed increase of capital stock in the sum of $400,000, the proposition was unanimously agreed to. The increase is on the basis of one share to each 20.25 shares outstanding. The new issue will bring the capital up to $8,500,000.——The Cleveland (O.) Gas Light and Coke Company has voted the sum of $1,500 each to Messrs. William Christie and Charles S. Beardsley, Superintendents of the Company's works, as partial compensation to them for losses sustained to their household effects because of the fire that recently destroyed a large box factory close by their residences. A rule of the Company requires its Superintendents to reside close by the works, and Messrs. Christie and Beardsley, in conformity to the rule, live in two houses owned by the Company and located on the latter's land. The act was certainly a most liberal one.——Any person or persons holding stock in the Brookline (Mass.) Gas Light Company desirous of parting with the same might dispose of their shares by communicating with the proprietors of the JOURNAL.——The Baldwin Locomotive Works take 300 bushels of coke each working day of the year from the yards of the Philadelphia city gas works.——The plan of levying a special tax for the public lighting of Salt Lake City, at so much per front foot for the property directly on the lines illuminated, which ordinance passed the Council some time ago, has been vetoed by Mayor Baskin.

A Systematized Photometrical Nomenclature.[1]

M. André Blondel has contributed to *La Lumière Electrique* a suggestive article upon photometric magnitudes and units, as to which he remarks that, of all branches of physics, photometry is the one which has been least improved in the matter of its system of units. Even the electrical congresses which have been held in succession since 1881, and have endowed electrical science with units in only too great profusion, so as to actually exceed the demand, appear to have thought that photometry only needed a good standard of light—which, by the way, it still needs. This is too optimistic a view; and there is now a reaction against it. Not that photometry as a science requires recasting in a fresh mould, since it is based upon a few firmly-established physical principles, which cannot give rise to any objections. Photometric nomenclature is, however, in M. Blondel's mind, open to criticism; and the number of photometric units strike him as being insufficient.

These shortcomings he proposes to supply in a manner to be discussed later on. The first thing which M. Blondel notices in photometry is that it has retained, without much alteration, the language given to it in the last century. For example, the classic phraseology gives the name of "quantity of light" to that which is really the *flux* of light; and thus puts itself in contradiction with the terminology of the cognate science of Heat. It would never enter the head of a modern student of Heat to confound the *quantity* of heat with its *flux*, for the first is a product of the second into the *time*. Hence it appears to M. Blondel the height of unreason to preserve this source of confusion in photometry; and accordingly he proposes that henceforth use should be made of the notions of flux and of quantity of light in exactly the same way as is done in the science of Heat. He also suggests that it would be a good thing to get rid of the word "brightness" (*clarté*), which every author uses in a different sense, and to definitely allocate the word "brilliancy" (*éclat*) to the intrinsic brilliancy of the source of light.

M. Blondel protests against the misunderstanding that exists with regard to the photometrical units. Of these he makes out that there are six, or rather that there are six fundamental quantities of photometry—viz., intensity (*intensité*), flux (*flux*), lighting (*éclairement*), intrinsic brilliancy (*éclat intrinsèque*) lighting-time (*illumination*), and quantity of light (*quantité de lumière*); the last being connected with energy. Yet there is a single unit—the candle—to serve for all, which leads to such conventional expressions as the "candle-foot." The first necessity, therefore, in order to restore rationality to photometry is to establish the notion of the *flux* of light, which is, after all, a perfectly natural notion, seeing that no initiation into scientific habits of thought is needed to enable anyone to perceive that light spreads itself in all directions. The irrational thing is the convention which expresses luminous output as well as the intensity of the light-source in candles. M. Blondel refers to the familiar trick of American electricians known (outside of France) as "French measurement," whereby an arc lamp sending out the light of 500 candles along four cross-roads is calculated to be of an illuminating power of 2,000 candles. He declares that the idea which underlies this trick is, in point of fact, a sensible one; because the quantity of most importance in lighting is really the flux of light, or the flow of light in all directions from its source; and if photometry does not contain an expression for defining a lamp with this in view, it is photometry which is at fault. Photometry is still more in the wrong when it conceals the idea of the flux of light under artificial terms, such as that of "volume of lighting" (*volume d'éclairement*)—a quantity which is obtained by calculating the lighting of every point of the ground underneath the light-source, and then integrating the product of each determination into the corresponding area. This "volume of lighting" is merely the flux of light emitted by the source over the corresponding solid angle, and therefore in no wise depends on the orientation of the ground lit up. Why, then, asks M. Blondel, instead of giving the quantity its proper name, compound this strange amalgam of photometry and geometry?

The confusion which has been permitted to arise between flux and intensity of light necessarily makes for corresponding ambiguity in the definition of "intrinsic brilliancy," which hardly two writers upon photometry use in the same sense. All this leads to the conclusion that it is high time a special unit was adopted for each separate photometric quantity, as done with everything else. Even the photographers have shown the lead in this direction; for they have already established a unit of time-illumination for their own purposes—the "*phot*." Accepting this lead, M. Blondel proceeds to review the different photometric

1. From the *Journal of Gas Lighting*.

quantities already mentioned for the purpose of determining their mutual relations.

1. The *luminous intensity* of a source of light in any given direction is the ratio of the flux emitted over a small solid angle which has this direction for its axis. The intensity is expressed in the terms of some unit of light. The unit adopted by the Congress of 1881 and the International Congress of 1884 is the "Violle;" being the light emitted by a square centimetre of the surface of molten platinum at the moment of solidification. This unit, after receiving such distinguished patronage, having proved practically useless, the Congress of 1889 had to adopt a secondary practical unit, which was the so-called "*bougie décimale*," imagined to be equal to the twentieth part of a "Violle." This result was deplorable, inasmuch as the "*bougie décimale*" has no real existence. It is not the tenth part of a Carcel, nor is it equivalent to the light of any known candle. In their desire to be universal, the Congresses which adopted these two absurd units did not even succeed in suiting the requirements of a single living photometrist; and, in consequence of this ineptitude, the photometrists of every nation have since gone their own way in search of practical light-units. M. Blondel suggests that the name *pyr*, from the Greek, should be given to whatever may be finally adopted as the unit of intensity of light. For the present, this might be taken to be the "*bougie décimale*." It is observed that there would be another advantage in the use of a new name, such as the *pyr*, for the unit of light intensity, in the fact that it would give a sort of scientific stamp to light measurements. M. Blondel appears to think that there is something common and over-simple about the word "candle," which is derogatory to the dignity of science. It does not matter if the *pyr* is really equal to a candle or not. This author holds that it would be a distinct advantage that the uninstructed public should be overawed by being talked to about *pyrs* of lighting effect! It is worthy of note here that the only objection which English science entertains with regard to the use of the candle as the standard of light is that its value is so difficult to determine, not that the term is so easy and common.

2. The *luminous flux* Φ should have for its practical unit the flux which takes place over a solid angle equal to unity from a source considered as a point having the luminous intensity of one *pyr*. The word "*lumen*" is suggested for this unit. A source of light having a mean spherical intensity of *n pyrs* would thus have a total flux of $4\pi n$ *lumens*.

3. The *lighting effect* e at a point of a surface is equal to the ratio of the luminous flux which falls on a small element of surface to the area of this surface—thus $e = d\Phi/ds$. It being absolutely necessary to adopt a new name for the unit of lighting effect in substitution for the local and conventional terms "*bougie mètre*" and "candle foot," M. Blondel appropriates the word "*lux*" proposed by Mr. W. H. Preece at the 1889 Congress, and makes it mean a "*bougie mètre*," or rather a "*pyr mètre*." According to the terminology previously indicated, the *lux* must be defined as "the lighting effect produced by a uniform source of light of one *pyr* intensity on a surface at right angles to the rays, and situated at a distance of one metre," or, which comes to the same thing, "the lighting effect produced on the surface of one square metre by a uniform *flux* of the *lumen*." Inversely, the *lumen* could be defined as "the luminous flux capable of illuminating a square metre of surface to the extent of the *lux*." The product of a certain number of *lux* into a surface measured in square metres will thus give a number of *lumens* representing the total flux received by this surface.

4. The *intrinsic brilliancy* i should have the usual meaning of the quotient of the intensity measured at right angles by the area of surface of the emitting source $i = I/S$. The practical unit of brilliancy is the intrinsic brilliancy of a source of light giving one *pyr* per unit of surface, being 1-20th of the brilliancy of the Violle standard. (This assumes that the area of surface of the standard is one square centimetre.) To be logically complete, we should also define the unit of *intrinsic radiation* of one *lumen* per unit of surface. In general, there is no simple relation between the intrinsic brilliancy and the intrinsic radiation; but when the source follows Lambert's law, a brilliancy of *n prs* per square centimetre corresponds to an intrinsic radiation of πn *lumens* per square centimetre.

5. Time illumination is, by definition, the product of the lighting effect e to which an object is submitted, into the duration of such lighting effect. The unit is the *lux-second*, which signifies the lighting effect obtained by an object from an illumination of one *lux* continued for one second. This unit is actually in evidence; having been adopted by the Brussels Photographic Congress under the specific name of "*phot*." It plays an important part in photography, since the chemical reactions appear to depend directly on the product $e\,t$. The same law holds good of certain physiological phenomena connected with vision and visual acuity, since a certain minimum duration of the lighting effect is necessary to create the impression of light. It is assumed in a general way that there must be about 10^{-8} *phot* in the plane of the pupil to enable it to perceive a punctiform source of light.

6. The *quantity of light* should no longer be confounded with the *flux of light*, as already observed. The quantity of light L is by definition, the product of the flux of light into its *duration*. It is therefore to be measured by the unit of the *lumen-second*, for which quantity the term "*rad*" has already been proposed by certain photographers. The *rad* may also be defined as the quantity of light received by a unit surface (1 square meter) exposed to an illumination of one *phot*. We can thus express in *rads* the quantity of light necessary to produce a luminous impression on the retina. For commercial purposes, it might be enough to measure the quantity of light in *lumen-hours* in the same way as the quantity of electricity is measured in ampere hours instead of in coulombs. This quantity, the *lumen-hour*, could be made the basis of lighting contracts. Since the quantity of light for radiation of given wave-lengths is proportional to the energy of the radiations, it might be possible to denote it in ergs, as with other forms of energy; but with polychrome sources of light, this datum has no simple relation with the photometric effect produced, since every radiation has a different coefficient of physiological action.

It now comes to be a question of how the units above defined could be used in proctice. M. Blondel begins by applying his suggestions to the measurement and expression of the luminous effect of an electric arc lamp, as to which he confesses that much uncertainty prevails. So notoriously is this the case, that, as he says, European electricians have mostly given up designating arc lamps otherwise than by their electrical constants. M. Blondel rightly scouts the American trick of calling an arc lamp a lamp of 2,000-candle power, irrespective of its true illuminating value. The alternative, however, is open to the objection of leaving too much to the quality of the carbons; and, after all, what the user wants is light. It is suggested that all uncertainty in this regard would disappear if electricians would agree to designate lamps by their total flux expressed in *lumens*, which is equivalent to their mean spherical intensity multiplied by 4π. A lamp of 30 spherical carcel power would thus become a lamp of 3,770 *lumens*. Artfully enough, the author suggests that the new system would give to lamp makers the satisfaction of expressing the performance of their lamps in bigger figures than are available by the present system, while the public would not be confused. This rating might be supplemented by stating how many *lumens* are emitted above and below the horizontal, seeing that the latter are alone of any value for street lighting. M. Blondel argues that when a town buys light from a company for the streets, this might be paid for according to the number of *lumen-hours* supplied during the year below the horizontal plane of the lamps; and he does not think that it would be impossible to draw up lighting contracts in this form.

With regard to the lighting of interiors, such as (say) a ball room, M. Blondel remarks that the eye judges of the illumination of a room by the average lighting effect e produced on the walls. This should be inversely proportioned to the diffusive power of the wall surfaces. We thus have, taking k as a constant, $e\,d = k$. If we call a the absorbing power, and S the superficies of the walls, we find (neglecting the effect of the furniture, etc.), that the total luminous flux which it is necessary for the lamps to produce should equal the flux absorbed, thus—

$$\Phi = a\,e\,S\,k\frac{a}{d} = S\,k\frac{a}{1-a}.$$

That is to say, it should be proportioned to the *total* superficial area of the exposed surfaces, and a certain number of *lumens* are required to the square meter. It might be possible to state the lighting effect of *pyrs* per square meter. But M. Blondel objects that this is a fundamentally vicious way of expressing it; and therefore it is better left in the form first given. For example, if $k = 5$ *pyrs*, and the coefficient of absorption of the walls $a = 0.60$, then 7.5 *lumens* will have to be produced per square meter of floor, roof and walls.

The most instructive of all the applications to which M. Blondel's suggested system of units is made by the author is, however, that of calculating and expressing the effect of a projector upon a source of light. Here the rationality of the idea of taking the flux of light as the starting point is most apparent, because the effect of applying a projector to a source of light is to reinforce the light radiated in a particular direction by a concentrated beam composed of all the radiations sent out in the opposite direction. M. Blondel's system offers a way of escape from the exaggerations and misunderstandings inherent in the ordinary methods of determining and stating the illuminating power of concentrated

beams. In conclusion, M. Blondel sums up his proposed system of units in the following table:

Physical Quantities.	Symbols and Defining Equations.	Dimensions.	Names of the Practical Units.
Luminous intensity.	I	[I]	*Pyr*, or "*bougie-décimale*," 1-20th of a *Violle*.
Luminous flux.....	$\Phi = I\sigma^*$	[I]	*Lumen*.
Illumination	$e = \frac{\Phi}{S}$	$[IL^{-2}]$	*Lux*.
Intrinsic brilliancy..	$i = \frac{I}{S}$	$[IL^{-2}]$	*Pyr* per square centimeter.
Intrinsic radiation..	$\phi = \frac{\Phi}{S}$	$[IL^{-2}]$	*Lumen* per sq. centimeter.
Time illumination ..	$j = et$	$[IL^{-2}T]$	*Phot* or *lux-second*.
Quantity of light ...	$Q = \Phi t$	[IT]	*Rad*, or *lumen-second*.

* σ solid angle; dimension; a number.

In taking intensity as the fundamental magnitude in constructing this system, the author follows present usages, without, however, connecting it with other physical units, because it is a physiological rather than a physical quantity. He thinks that this system of units, being in conformity with those applying to electricity and magnetism, could be adopted, as those have been; and he professes to be unable to understand why that kind of systematizing which is generally recognized as being useful and even necessary in every other branch of physics should be deemed superfluous in photometry.

We are indebted to the *Electrician* for the full literal translation of M. Blondel's article from which the foregoing abstract has been made. In giving currency to his views, it is desirable to accompany them with a few points of the criticism offered on the subject by our contemporary in an introductory article. It is admitted that the "flux of light," upon which M. Blondel bases his suggested system, exists; but it has unfortunately not been recognized in the nomenclature of photometry. It is one thing, however, to admit this physical truth, which must be obvious as soon as attention is drawn to it, and quite another to introduce a term for it into the current language of photometry, with its positive commercial bearings. Upon this head our contemporary remarks as follows:

It seems highly probable that in this country and in America the "candle power" will remain, while its magnitude may perhaps be adjusted by a congress or by the Board of Trade. The unit of luminous flux may, perhaps, deserve a name; but it cannot be a "candle." The idea that a light of 1-candle power gives the light of 4π, or 12.57 "candles," though technically true, would be too absurd. This flux is often spoken of as "total light," or "quantity of light." This is not quite accurate. We really mean, as it were, a current of light or rate of emission of luminous radiant energy. The product of this by unit time would give a true quantity. M. Blondel's last unit is of this kind; but it is not likely to be often required. It is, under certain circumstances, necessary to employ the notion of a flux of light; and it is wrong to describe the unit as 4π-candle power. Hence the need for a name. If some name is not adopted, enterprising lamp makers will advertise lamps of 201 candles, meaning 16-candle power. The third unit, that of illumination, really needs a name. M. Hospitalier and others have strongly objected to the "*bougie-metre*" and to the "candle foot;" and, with some sophistry, it has been argued in defence that, although there may be a little ambiguity in speaking of "7.5 candle feet," there is nothing unsound in "7.5 times a candle foot." It is a question whether M. Blondel's "illumination," "intrinsic brilliancy," and "intrinsic radiation" might not be reduced to a single unit. It will be seen that their dimensions are identical. There is a very simple connection between them, and a little examination will show that the same unit will do for each. Suppose a light of k-candle power has an effective luminous area of a square feet. If the light be an opaque incandescent sphere of 1 foot radius, it will show in any given direction a projected area of π square feet, or the same as a disc of 1 foot radius. Its brightness or intrinsic brilliancy is its candle power per unit area, or k/π-candle power per square foot. The total quantity of light, or luminous flux, emitted by the sphere is $4\pi k$ units; and the illumination it can produce at a distance of f feet (this distance being not less than 8 or 10 feet) is k/f^2 candle feet. If it be desired, then, to know the quantity of light given out per unit area of a luminous body, this is at once obtained from the brightness by multiplying by π. Now, the total flux of light emitted by the sphere is $4\pi \times k$ units, and the total area of luminous surface is $4\pi \times 1^2$ square feet; hence the intrinsic radiation, which might, with some reason, be called the illumination of the luminous surface, is $(4\pi \times k) / (4\pi \times 1^2) = 1$ candle foot, where $k = 1$. This, as we have already shown, is π times the brightness—a relation which always holds good. The surface of such a self-luminous sphere emitting pure white light cannot be distinguished from a non-self-luminous sphere dead white, reflecting or scattering cent. per cent. of the light falling on it, and illuminated from some external source with the illumination of 1 candle foot. As a corollary of some interest in connection with dead white reflectors, it may be remarked that a perfect white reflector of 1 square foot illuminated with π candle feet emits 1-candle power normally.

We agree with the above generally. It is impossible to form an accurate notion of the phenomena of lighting, including such effects as projection, reflection and diffusion, all of which are of great practical moment, without keeping in mind the fundamental idea of light as a flux. Practical photometry has only taken account of the illuminating power *in one direction* of a light source. In order to make this measurement with a reasonable degree of accuracy, it has been the practice to compare the light of the source to be measured against that of a standard of light, setting the one over against the other, and screening off all but those rays which directly follow the line passing through the two lights and the screen placed between them for the purpose of determining the point of equal lighting effect. Moreover, it has been necessary to suppress, as far as practicable, all reflection and dispersion effects in and about the photometer by blackening all the surroundings of the instrument. Even in the best constructed photometrical chamber, however, it is impossible to completely eliminate these effects; while in actual lighting their influence is more easily perceived than measured. The only other observation we have to offer here upon M. Blondel's suggestions is that, although the author at first recognizes, he subsequently ignores the fact that, out of France, the so-called units of the "*bougie décimale*" and the "*bougie décimale mètre*" do not hold good. His appropriation of the term "*lux*," moreover, to mean the latter quantity, is unwarrantable, since it has already a meaning—the light-effect produced by a British standard candle at 1 foot distance.

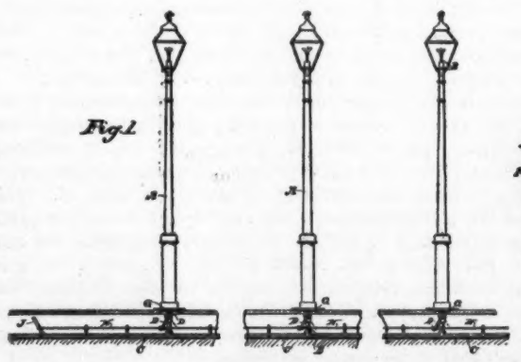
Kewell's Apparatus for Lighting or Extinguishing Gas Lamps.

On November 24th, U. S. Letters Patent (No. 529,449) were granted to Mr. Charles Kewell, of San Francisco, for an improved apparatus for lighting or extinguishing gas lamps. Using the words of the specification:

The invention relates to a means for lighting and extinguishing street lamps in series without the expenditure of time necessary to attend to each lamp separately.

It consists in certain details of construction which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a sectional elevation, showing the lamps and their connecting device. Fig. 2 is a detail of the flame protector.



A represents a street lamp post of any suitable or desirable description, the pipe *B*, which conveys gas to the burner, extending down through the post and connecting in the usual or any suitable manner with the main *C*, which extends along the street.

A cock *G* is fixed near the lower part of the supply pipe *B* to turn on or off the supply of gas as may be desired. This cock is actuated by a crank arm *D* which connects with a light rod *H*, which preferably extends through bearings mounted along the upper part of the main *C*, or

within a protecting passage at the edge of the walk along which the lamps are disposed at suitable intervals. When this rod is moved in one direction, it will open simultaneously the whole line of cocks, and when moved in the opposite direction it will close them.

At the end of the street or division which is to be operated by any one rod or line, is fixed a hand lever *J*, or suitable connection, by the movement of which the rod or connecting device will be actuated, thus turning on any number of lights at one time.

The gas burner itself has a light protecting shell *F*, which partially incloses it, leaving an opening through which the gas passes when the light is fully turned on.

When the light is turned off, the cock does not entirely cut off the supply of gas from the burner, but leaves a very small amount flowing, which keeps up a small flame inside of this protecting cap. This flame does not use much gas, but is sufficiently large to keep up the required combustion under the protecting cap, so that when the gas is turned on full head it will be instantly lighted, and at all the various lamp posts, without any further attention.

The inventor's claims are:

1. The combination, with the street lamps and their supply pipes connected with the gas main, an underground conduit into which said pipes extend, cocks on the pipes within the main and each provided with a crank arm *D*, a sliding rod *H*, extending longitudinally through the conduit and pivoted to all of the said cranks, and a pivoted lever in the conduit and pivoted to the sliding rod to move it positively in both directions; the conduit having a covered opening over the said lever to permit access thereto, substantially as set forth.

2. The combination, with the series of street lamps, a conduit therebelow, a gas main *C* in the conduit and provided with a series of bearings, pipes connecting the main with the lamps, and provided with cocks within the conduit, each of said cocks being provided with a crank arm *D*, a sliding rod mounted in the said bearings and pivotally connected with the said cranks, and an operating device connected with the said rod and adapted to positively throw the rod in both directions, substantially as set forth.

A Method for Determining Calcium Oxide in Quicklime.

Messrs. W. E. Stone and F. C. Scheuch, of Purdue University, report the following method for determining calcium oxide in quicklime:

The value of quicklime is based upon the amount of calcium oxide which it contains. This value may be diminished by the presence of other substances originally present in the limestone, consisting usually of magnesia, alumina, silica and iron; by incomplete ignition in the limekiln, on account of which some calcium carbonate fails to be converted into calcium oxide; and lastly, by a partial "slaking," by which a portion of the calcium oxide reverts to calcium carbonate.

An analysis of quicklime, therefore, should show not only the amount of calcium present in distinction from other elements, but should distinguish between the calcium as oxide and other forms of combination. The customary gravimetric method, based upon solution of the calcium compounds in acids, precipitation as calcium oxalate, ignition, etc., attains only the first of these requirements and affords no data for judging of the original condition of the calcium thus found. Consequently this method may furnish erroneous conclusions with regard to the commercial value of the material examined.

The method here proposed enables one to determine with a high degree of accuracy and rapidity the actual amount of calcium oxide in quicklime. It is based upon the well-known fact that the alkaline earths form definite compounds with sucrose, called saccharates. Several such compounds are known with barium and strontium. With calcium oxide, sucrose forms at least three compounds, the mono-, di- and tricalcium saccharates, containing respectively one, two, and three molecules of calcium oxide to one of sucrose. The two first are formed when quicklime is dissolved in the cold in a sucrose solution. On heating this to boiling, a precipitate is thrown down consisting in the main of the tricalcium saccharate.

Numerous authorities may be quoted with regard to the solubility of calcium oxide in sucrose solutions, of which the two following will suffice for citation.

Berthelot[1] gives the maximum solubility in solutions of sucrose of varying strength:

Grams sugar in 100 cc.....	0.096	0.400	1.058	1.386	2.000	4.850
CaO dissolved.....	0.154	0.194	0.281	0.326	0.433	1.031

The following data are from Schatten.[2]

1. *Ann. Chim. phys.* [3], 46,176.
2. Von Lippmann, Die Zucker-Arten, 109,

In 10 grams of sugar solution of different percentages:

Per cent..... 1	4	8	12	16
Grams CaO dissolved... .....0.029	0.080	0.160	0.271	0.394

Numerous other references indicate the ready solubility of calcium oxide in sucrose solutions, and the apparent possibility of applying this fact to the separation of the actual calcium oxide from the other constituents of quicklime, led us to make the following studies:

1. The conditions under which calcium oxide is dissolved in sucrose solutions.

Lamy[1] has shown that solubility varies inversely with the temperature. Ten liters of 10 per cent. sucrose solution, at the given temperatures, dissolved the stated amounts of calcium oxide.

Temperature C°..... 0°	15°	30°	50°	70°	100°
Grams CaO dissolved.....250	215	120	53	23	15.5

For our experiments, pure calcium oxide was prepared by igniting pure calcium carbonate to a constant weight. It was found by repeated experiment that 1 gram of this material was easily soluble in 150 cc. of a 10 per cent. sucrose solution after agitating 15 to 20 minutes at ordinary temperature. To accomplish perfect solution it was necessary that the material be finely pulverized. If heat were employed, the lime was converted into a pasty, insoluble mass, which, however, dissolved on cooling.

2. The degree of solubility of calcium oxide in sucrose solution. Repeated experiments gave the following results:

One gram of pure CaO was only partly dissolved in 100 cc. of a 5 per cent. sugar solution.

One gram of pure CaO was only partly dissolved in 150 cc. of a 5 per cent. sugar solution.

One gram of pure CaO was only partly dissolved in 100 cc. of a 10 per cent. sugar solution.

One gram of pure CaO was completely dissolved in 150 cc. of a 10 per cent. sugar solution.

From these results it appears that not less than 150 cc. of a 10 per cent. solution of sucrose could be safely employed to dissolve the calcium oxide in 1 gram of quicklime.

3. Behavior of other constituents of quicklime toward sucrose solutions:

Besides calcium oxide, quicklime usually contains more or less iron, alumina, magnesia and silica. In addition to these, calcium carbonate may also be present. The behavior of these toward sucrose solutions was studied in detail with the following results:

Magnesia. Pure magnesium oxide, specially prepared, was treated with a 10 per cent. solution of sucrose. One hundred and fifty cc. of the latter, after shaking with 1 gram of magnesium oxide for 30 minutes, were filtered and treated with ammonia and sodium phosphate, but only the faintest turpidity resulted. Again, 1 gram of magnesium oxide was shaken with 150 cc. of sucrose solution, filtered, and the filtrate titrated with a standardized hydrochloric acid, and an equivalent of 0.001 gram of magnesia was found, or one-tenth of 1 per cent. These results show that magnesia is not appreciably soluble under the given conditions. Indeed, the existence of a compound between magnesia and sucrose is doubted. On the other hand, magnesia is said to be freely soluble in a solution of calcium oxide in sucrose.[2] To test this point, mixtures of pure magnesium and calcium oxides were treated with sugar solutions as follows: One-half gram of each were mixed and shaken with 150 cc. of sugar solution. A considerable portion of the material was insoluble. We filtered and titrated the filtrate with standardized acid, the result being an exact equivalent of the calcium oxide employed. Again, one-half gram of each were mixed and treated with sugar solution as before. We filtered and precipitated the calcium from the filtrate by means of ammonium oxalate. The filtrate from this showed only slight turpidity when treated with ammonium and sodium phosphate. These results show that magnesium oxide is not soluble to an appreciable degree in sucrose solution containing calcium oxide, under the stated conditions.

Alumina was found quite insoluble, no appreciable amount being found in the filtered sucrose solution.

Calcium carbonate was also insoluble to any appreciable degree in the 10 per cent. sucrose solution under the stated conditions.

Ferric oxide, shaken with 10 per cent. sugar solution, was also insoluble. Schactrup and Spunt[3] mention that ferric oxide inverts sucrose but not in an alkaline solution. We have verified this by heating a small quantity of ferric oxide with a sugar solution; the latter soon acquired the power of reducing Fehling's solution. But when the same experiment was repeated, with the addition of some calcium oxide, no

1. *La Sucrerie indigene et Coloniale*, 11, 19.
2. Von Lippmann, *Die Zucker-Arten*, 148.
3. *Pharm. Cent. Halle*, 34, 148.

inversion occurred. It is evident, therefore, that the iron contained in quicklime would not be affected by sucrose solution.

4. The determination of calcium oxide when dissolved in sucrose solution:

Calcium oxide, when dissolved under the preceding conditions, admits of determination, either gravimetrically by precipitation as calcium oxalate, or volumetrically by titration with hydrochloric acid. Several comparisons of the two methods were made, using known amounts of pure calcium oxide, and while each was accurate to the extent of yielding the theoretical numbers, the volumetric method was found preferable on account of its greater rapidity. For the latter method, standardized hydrochloric acid of about fifth-normal strength was employed, using tropaeolin or rosolic acid as an indicator.

5. Application of the preceding data to the analysis of quicklime.

Following the conclusions derived from the preceding tests, several samples of quicklime were analyzed for calcium oxide. They were all in a fresh state and contained little calcium carbonate.

In each case, approximately 1 gram of the finely pulverized material was shaken with 150 cc. of a 10 per cent. sucrose solution during 20 minutes, the solution filtered and the clear filtrate titrated with standardized hydrochloric acid. At the same time other portions of the same samples were dissolved in hydrochloric acid and the calcium determined in the usual way by precipitation as calcium oxalate. Following are the results:

Sample.	Weight of Quicklime Taken, Grams.	Volume of 10 Per Ct. Solution of Sucrose Taken, cc.	Per Cent. CaO by Titration Method.	Per Cent. CaO by Gravimetric Method.	Variation of Volumetric Method.
No. 1....	1.020	150	92.12	93.00	—0.88
" 2....	1.090	150	91.90	92.28	—0.38
" 3....	1.003	150	92.15	93.10	—0.95
" 4....	1.108	150	95.01	95.90	—0.89
" 5....	1.023	150	87.30	87.70	—0.40
" 6....	1.232	150	91.70	92.30	—0.60

The results by the sucrose method were in each case slightly lower than by the gravimetric method discrepancy which may be ascribed to a small amount of calcium carbonate present in the sample.

In quicklime which had become partially slaked, this discrepancy would be still greater, since the sucrose method would indicate only the actual calcium oxide. Aside from this, the greater ease and rapidity of the latter recommends it in cases where the total calcium is present in the form of the oxide. An entire determination may thus be made in a half hour with a degree of accuracy quite sufficient for all ordinary purposes.

What Is Electricity?

Mr. Sydney F. Walker, in replying to this question, says:

Readers of my previous articles upon this subject will remember that the view I have ventured to put forward as to the nature of electricity is that it is simply a mode of motion, just as heat, light and sound are, but at a different rate, and possibly in a different manner, to either of those forces. I have already pointed out the close similarity that exists between the different forces named and electricity, in the fact that conduction takes place in all of them under very much the same laws; that the presence of any one of them, electricity included, in any body increases the apparent size of that body; and that all, though necessarily in different degrees and with different substances, possess the property of altering the chemical constituency of compound bodies.

Seeing that the different forces represent different forms and rates of motion, we should necessarily expect that there would be diversities in the similarities of their resultant action, and, further, we should expect that some properties would be peculiar to one or more rates of motion, to one or more of the forces, but not common to all. The more features of similarity, however, that we find between a force supposed to be outside the group and those known to be inside, the stronger does the argument become that the outsider is really one of the group. If, therefore, we can show that electricity or electric waves are reflected and refracted as heat and light rays are, we shall have a strong argument in favor of my contention that electricity is a mode of motion, like the other physical forces.

As students of electrical literature are aware, the late Professor Hertz went a very long way towards proving this, and he actually succeeded in obtaining reflection of electromagnetic waves. What Professor Hertz actually proved was, that if in the path of a series of electromagnetic waves created by an induction coil an object be placed capable of reflecting those waves, just as mirrors reflect waves of light or heat, the actual phenomena of reflection were obtained. My object in drawing attention to this is the hope that some of those who have the time and the appliances at their disposal will carry on Professor Hertz's experiments to their logical conclusion, and prove or disprove my supposition that an electrically-charged body is sending waves into space, just as a luminous, a heated, or a sounding body does, and that these waves may be caused to reflect and possibly also to refract.

In order to pursue this investigation with advantage it may be well to inquire what we mean by reflection, since it will be evident that a substance that reflects one of the physical forces may not reflect another. To follow the theory I ventured to put forward in one of the earlier articles, the rate of motion already existing in any particular body on which a ray impinges may be such as to combine readily and fully with the motion brought by the ray when the latter is, say, a ray of heat, while it may not be able to combine with a ray of electricity, supposing such to exist. In the case of the reflection of light rays, we see this selective property exercised all around us. Thus, a substance we know as black has the property of absorbing and, on the theory enunciated above, of combining with the whole of the motion brought by the impinging ray.

A substance we know as red is only able to absorb a portion of the motion, reflecting the remainder out again, and giving us the phenomena of color. A substance that is white, as we know, absorbs very little of the motion brought by an impinging ray, reflecting nearly the whole of it; while, again, bright polished substances, such as mercury, silver, and to a lesser degree copper, and other colored metals, have the property, not only of reflecting a mass of light rays, but of reflecting every ray brought to them in the exact inverse order in which they arrive.

To reflect electric rays, then, we require to find a substance that does not readily absorb a charge of electricity, or, in other words, one which, while it is a poor conductor, has also a small electrostatic capacity. An experiment I think that should prove successful might be made with a large hollow metal sphere charged to a very high potential, and the neighborhood explored with a sheet of ebonite and a light pith ball. If waves of electricity are given out by the highly charged sphere, just as waves of sound are given out, say, by a tuning fork, evidence of them would be found and of their reflection. Possibly a careful consideration of some of the phenomena of electrostatic induction may lead to the conclusion that this also is only a form of reflection.

The Selection of Motive Power.

By Mr. Charles E. Emery, Ph. D., in *Engineering Magazine.*

In selecting a motive power for a new manufactory a prudent manager would naturally inquire if there were any new developments on the subject, and ask as to the relative standing of well-known means in view of modern improvements. The inquiry cannot be limited to apparatus required for a particular purpose, subject to the conditions which obtain at a particular place, but must indicate the principles of selection for differing conditions, and may even involve the examination of a location with reference to its advantages for obtaining not only power, but suitable labor and accessible markets. The subject is, therefore, necessarily approached in a general way. We should at first realize that all power in sufficient quantities for manufacturing purposes is obtained by utilizing in some way one or more of the various forces of nature. The energy of the sun expended in lifting the vapor of water to the clouds is returned and in part utilized by man as the aggregated rain drops find their way in the streams from the slopes to the sea. To the same source of energy the changeful winds owe almost exclusively the motion and force familiarly utilized on sea and land. Even the heat derived by burning the trees of the forest represents a portion of the energy of the sun, which has changed inorganic incombustible matter into organized combustible tissue and fiber, and thereby stored up energy in the past for use in the present. It is more important than all to recollect that this operation has been going on for ages, and that our coal fields and supplies of mineral oil represent also the energy of the sun stored in prehistoric vegetation buried in the earth and transformed in the laboratory of nature. Abstractly, then, the question is whether we shall derive our motive power from the sunlight of the present or from that of the past. A prominent distinction at once appears. All direct forces from the sun now available, whether they be from the winds or the waters, are of the varying character familiar in everyday life; whereas energy stored, whether in the form of coal, mineral oil, or even wood fiber, can be expended to produce heat and power at will. On the same principle the varying forces derived from water can be better utilized by the various familiar systems of storage. It would appear, then, from considerations of a very general nature,

that the most reliable power must be secured from mineral fuel, consumed at will, and the power next in reliability, from water stored in great natural reservoirs.

The power derived from the fuel must in general be obtained from a heat engine, of which the steam engine is the most familiar type and that most generally employed. The steam-engine has therefore become the standard to which the cost of all sources of power is referred, although in special locations power may be obtained more cheaply in another way.

Water is a primary source of power, as the potential energy due to its elevation may be directly transmitted into mechanical work. Steam is, however, a secondary source, as it is only a means of transmuting into mechanical work the energy stored in the fuel and available as heat. Both primary and secondary sources may be easily confused with mere means of transmission. Electricity is not a source of power. It may be made a secondary source in the same sense as steam, by the discovery of a practical method of generating it on a large scale from the direct combustion of fuel. At present it is only a means of furnishing at one point power developed at another, and in this respects stands in the same category as hydraulic and compressed air transmissions, and, except for some purposes relating to the distance covered, acts on the same principle as transmissions by wire ropes, belts, or ordinary shafting. Every means of transmission must be operated by a true source of power, like a steam-engine or a water-wheel, and in the abstract, where the greatest efficiency is obtained, the efficiency is higher the less the number of parts interposed between the source of power and the point where the same is utilized. Transmission of steam is distinguished from the above by the fact that it permits the boilers to be located at a convenient point and the steam to be used where heat or power is required.

Approaching the details of the subject, we first call attention to the fact that the power available by the use of windmills is by no means small or valueless. They make the continuous drainage of the lowlands of Holland practicable, and mills requiring 80 horse-power and upwards are successfully operated by a single wheel. The system is not, however, well adapted for locations where the wind is light and variable and where coal is as cheap as in most locations in this country. In some places along the coast the wind blows so much of the time, and so strongly in one direction, that isolated trees lean away from it and are distorted by having foliage principally on the leeward side. These living wind vanes clearly point out the possibility of using windmills for power in such localities. There are many things, however, to think of before making such an installation. In the best location the wind is liable to fail at inopportune times, and a given output can only be obtained by frequently working during during the night. Such a system would therefore not be popular where the general feeling of labor organizations, and indeed of all wage-earners, leans towards a definite number of hours of labor and a definite output in proportion thereto, with the remainder of the day available for social enjoyment or mutual improvement. Where labor can be changed from one place to another, as on a farm, windmills are very useful, and particularly where fuel is scarce. The windmill manufacturers make many sales in the West and other parts of the country where the conditions warrant the use of such a power. Windmills, as we know them in this vicinity, are chiefly used for pumping water, and, being of the American automatic type, care for themselves under all possible varying conditions; and although water is pumped only when there is sufficient wind, it is stored in tanks and thus made available for use when the wheel is at rest. Competition has made this type surprisingly cheap. Mr. Brush, the electrician, constructed at his country-seat an experimental plant in which a windmill was used to generate electric current and charge storage batteries from which such current was utilized about the premises. This system has recently been suggested by others for general use, and should be feasible and possibly profitable in favored locations if operated on a sufficiently large scale to warrant the employment of the skilled labor necessary to keep in order the batteries and other apparatus, particularly the several automatic devices necessary to practically convert a changeable source of supply into energy available continuously.

Leaving the general question of water power until it can be conveniently compared with steam power, we will examine the availability of heat engines other than steam engines. Hot air engines have not come into general use for miscellaneous power purposes. They are practicable on a large scale by the use of temperatures and pressures so high as to prohibit in a sense general use. There are, however, some small engines largely used for pumping purposes which work within such reasonable limits as to give little or no trouble. The original form is that designed by Ericsson. In the base of the apparatus a small fire of gas or coal is kept burning and heats directly a shell pendent from a cylinder containing a piston with pendent plunger, between which and the hot bottom cold air is forced as the plunger rises, which, being heated, completes the upstroke, when an exhaust valve opens, the plunger is returned by the action of a fly-wheel, and the operation is repeated. The Rider hot-air engines operate successfully on a very similar principle, but with entirely different details. Both these forms of engines are used by ordinary help to pump water from the street mains to an elevated tank. There is no possibility of an explosion, and the danger of overheating is entirely prevented if the operator once gets the pump started, for then any extra heat only increases the speed.

Gas and petroleum engines of various kinds are largely used for power purposes. In one form of the latter, used largely in naphtha launches, naphtha stored in tanks on the vessel is injected into a coil heated by a naphtha lamp, and the resulting naphtha vapor is used in a small engine like a steam engine. Generally, however, naphtha or crude petroleum is sprayed directly into the cylinder of an engine, where it is vaporized by the heat, when the operation is the same as in a gas engine—viz., the vapor or gas is mixed with air and exploded by a fixed torch, causing intense pressure utilized on a piston, and a high temperature controlled by a water jacket. Gas and petroleum engines have some advantages for detached locations, where they receive only the occasional attention of careful but unskilled labor, as the operations are all automatic. A comparatively small quantity of naphtha or oil is placed in a tank at the base of the petroleum engine, and, with the same reasonable care that would be exercised in handling petroleum for lamps, there is little danger of fire. In general, the larger quantities of oil are stored outside in underground tanks, and in some cases it is provided that no store is kept about the engine, but the quantity required for each stroke is withdrawn from the tank outside by means of a pump. Where gas is available from a street supply, the installation of a gas engine is simpler than that of a petroleum engine, as it only requires a pipe connection to the gas service; otherwise the two forms of engine are generally very similar in appearance, construction and operation. There is some jar and noise due to the explosions, which must be provided for in locating the engine in dwellings. Generally, by bedding the engine on soft earth or sand, without permitting any connection of the same to touch the walls or a common rock foundation, the noise and jar will not be communicated so as to cause annoyance. Prof. Elihu Thomson has installed a petroleum engine built by one of his companies, affiliating with the General Electric Company, for generating electric lights for his home at Swampscott. The cost is found to be somewhat less than would be required for a steam engine of small power, though greater than that of power derived from steam machinery of large size. It should be remembered by those desiring small power for use about a country house that every form of apparatus for furnishing the same is liable at times to special derangements and requires occasionally skilled adjustment and attention, so that annoyance, when ordinary labor is employed, is sure to come sooner or later, and the selection of a motor in such a location is therefore, in some respects, a choice of evils. The difficulty is largely diminished if the owner himself will take pains to familiarize himself with principles and details so as to know what should be done in an emergency. If he, therefore, takes the place of a skilled engineer, the particular kind and style of motor should be one which he believes adapted for the purpose, and will, therefore, care for in the most efficient way. The same principles are applicable in selecting power for a small factory.

There is, however, a field for gas engines where a supply of ordinary illuminating gas is not available. There has been in operation in England for a number of years a system in which gas is generated in a "producer" resembling that used in steel and other furnaces. The principle is that of heating a quantity of coal in a simple cylindrical vessel by admitting only a sufficient quantity of air to produce imperfect combustion. The effect is to drive off with the waste gases carbonic oxide gas, which is combustible, mingled with hydrocarbon gas, if the coal is of the bituminous variety. The mixture, called "producer gas," is used in a gas engine having the general features above described. Plants of this kind have been installed of from 25 up to 400-horse power and are said to operate efficiently. The economy of small gas engines under experimental conditions is considerably greater than that obtainable with an ordinary steam engine, a result as low as 1¼ pounds of coal per indicated horse power per hour being claimed by the manufacturers. Comparing this system with a steam engine, it will be seen that the producer in a sense takes the place of a steam boiler, that producer gas is employed instead of steam, and that a distinctive gas engine is required instead of a steam engine. The number of parts necessary to do the

work is therefore not varied, and the number of transformations is the same. In the steam engine the heat of the fire is imparted to water, and the water used in the engine. In the gas engine a part of the heat of the fuel is used to produce the gas, and the explosion of a mixture of the latter with air produces the power. The gas engine is theoretically the more economical simply because fixed gases are employed and operation depends largely on variations of temperature or changes of sensible heat; whereas with steam a certain quantity of latent heat must be imparted to the water to form steam, and is retained in order to maintain the water in the state of vapor when the exhaust takes place. In practice care must be taken to keep up a regular action of the producer so as to supply a uniform quality of gas. On account of the difficulty in doing this, it is believed that the economy obtained in practice is not always in excess of that of the steam engine. The want of uniformity of the gas applies to large as well as small gas apparatus, whereas steam in large quantities can be generated and utilized continuously under conditions of maximum efficiency. It does not appear, therefore, that gas engines and accessories can as yet compete on equal terms with large steam engines in their present perfected condition. The wear and tear of gas engines are, moreover, necessarily greater than those of steam engines.

There is a future, however, for gas engines by generating producer gas cheaply at the mines, using even the waste coal for the purpose, and piping such gas to a long distance to operate gas engines in the way described. A modification has been proposed in England in which the gas engines were to be operated in the immediate vicinity of the mines to generate electricity which would be conveyed to long distances for power and even heating purposes. The prospectus of this scheme showed a very large saving compared with using fuel in the ordinary way. With all due allowances for the claims of sanguine inventors and promoters, it is believed that something will be accomplished along these general lines within a reasonable period.

The advantages of the steam engine where fuel is reasonably cheap need not be strongly urged. Its use has been extended so rapidly as to make it an important factor in the growing civilization and prosperity of mankind since the days of Watt. It can be employed anywhere that fire can be permitted, in quantities small or large; the power is readily controlled, and the apparatus in all details easily handled by all persons of intelligence after a reasonable preliminary education and experience. It has been so tested by long practice that the details of construction for engines of the same type made by different manufacturers are substantially identical, and, though there are good and bad features among the so-called improvements, they are of too varied and technical a nature to be treated in this article, and the services of an engineer are necessary to point them out. We can only call attention to the advantages of several distinguishing types of steam machinery. First, as to boilers: The plain vertical tubular is best for small power and particularly for semi-portable engines; the more expensive locomotive boiler is best for self-propelling portable engines; and the horizontal tubular boiler set in brickwork is in some respects best for general factory purposes, the sizes being fixed by the pressure to be carried and the power provided for by duplication. These boilers do so well that parties get in the way of thinking they will take care of themselves, and occasionally disastrous explosions occur.

There is, therefore, a growing preference for the so-called "safety" boilers, constructed principally of water tubes and connecting vessels of small size, with a very large surplus strength, or, as it is called, a large "factor of safety." It is not proper in this article to attempt to discriminate between the different kinds of boiler of this type. In making a selection the question of reliability under conditions of actual and long-continued service should be considered, rather than mere differences of cost. Engines are in general distinguished as follows: "Non-condensing engines," from which the steam is delivered into the atmosphere or into a low-pressure heating system; "condensing engines," from which the steam is condensed either by admitting cold water to a separate vessel or by precipitating the steam upon surfaces kept at a low temperature by circulating water, or in some cases by large volumes of air; "compound engines," in which the steam is worked serially through one or more cylinders, increasing in size so as to secure expansion and reduce internal cylinder condensation. Such engines are called "simple compound engines" when there are two cylinders in series, "triple compound engines" when there are three such cylinders, and "quadruple compound engines" when there are four such cylinders, etc. In contradistinction to the above, non-compound engines are frequently called "simple engines." Engines of less than 50-horse power are generally simple non-condensing engines. Non-condensing engines of larger size are also employed where it is difficult to obtain condensing water or where the exhaust steam can be used for the purpose of heating buildings or the various fluids required in dyeing or other manufacturing processes. Simple condensing engines are rarely made of less than 75-horse power, and more customarily are of 125-horse power and upward. Until quite recently they were used universally for factory purposes, single cylinders being employed up to 250 and occasionally 500-horse power, and for larger engines two cylinders were employed, doubling the power. To provide a reasonable amount of steam for heating and other purposes about the factory, it was not uncommon to make one end of one of the cylinders non-condensing, by the use of a separate exhaust pipe quite readily arranged with engines of the Corliss type. Of late, such engines are only used where coal is comparatively cheap, and compound engines are employed in their stead, a small cylinder being arranged behind a large one for a single engine, and the same arrangement duplicated for a double engine; or, one of the cylinders of the double engine is made larger than the other and the exhaust taken across from the smaller to the larger, making what is termed a "cross-compound engine." When reasonable quantities of steam are required for various heating purposes in a factory using this kind of engine, it is customary to take the steam supply for heating from the intermediate chamber between the two cylinders, thus reducing to that extent the power of the larger cylinder only. The steam pressure employed for these three types of engines is about the same, or from 80 to 100 pounds. With the more general introduction of the compound engine the pressure has been raised to 125, 150 and 160 pounds. As it became practicable to use boilers adapted for higher pressures, a number of triple compound engines have been introduced, operated in some cases with pressures the same as for simple compound engines, but some plants have been built to use a steam pressure of 200 pounds.

The advantages of high-speed engines were pointed out by Mr. Chas. T. Porter years ago, and many engines of the Porter-Allen type have been constructed. The system was not, however, generally extended until after the experiments of the writer at the Novelty Iron Works in 1868, which showed that a high speed of revolution had the effect of reducing cylinder condensation. The adaptation to this type of engine, by Mr. J. C. Hoadley, of a governor located in the flywheel, operating to move an eccentric transversely across the shaft, and thus produce variable expansion with a single lap valve, had the effect of making these engines govern excellently, and show a fair efficiency with a very simple construction. Small engines of this type are frequently run up to from 250 to 350 revolutions per minute, and, although their weight is much greater than for the same size of cylinder with ordinary engines, they still contain less material than slow-speed engines developing the same power; so the high-speed engines can be furnished for less first cost, and have become quite popular for many purposes, particularly for small electric lighting plants. Manufacturers are frequently tempted to select this type of engine on account of its comparatively low price. Such engines are, however, made for hard service, with simple details and ample clearances, and the valve gear, though efficient, does not generally give as good results as that used on slow-speed engines. The consequence is that the high speed engines, as a rule, are not as economical as slow-speed engines. Moreover, on account of the high speed, though very carefully constructed, they generally require more careful attention. In some forms, features of automatic lubrication have largely eliminated the difficulty, but results show that if from neglect a journal heats, the temperature rises more rapidly, and is therefore more destructive on the average with a high-speed engine than with a low.

The success of high-speed engines has led to increasing the speed of forms previously known as slow-speed engines, with very advantageous results. It is found, for instance, that it is practicable to operate a Corliss engine of 42-inch stroke at 100 revolutions per minute, giving a piston speed of 700 feet per minute. Similar engines of 5-feet stroke have been run up to 80 revolutions per minute, giving a piston speed of 800 feet per minute. Such engines work satisfactorily, and seem to require little more attention than larger engines developing the same power.

Reminiscences of By-Gone Electrical Days.

By Mr. Fred. A. Scheffler, in *Cassier's Magazine.*

There are, without doubt, many persons among the electrical fraternity who can recall various peculiar circumstances and results attending the sale or introduction of the electric light, incandescent or arc, particularly those who were fortunate (?) enough to have been in the field in the early days. It may not be remiss to record at the present time some recollections of the method adopted by the writer and others

known to him for effecting sales or introducing the electrical apparatus to certain unbelievers in such cases where the usual truthful stories would not be believed, especially where the use of the arc lamp was compared with that of the incandescent, and the latter with the cost of gas.

I have no doubt that were the experiences of many of the representatives of the electrical companies placed on record, dating from 1881 to the present time, there would be many volumes of excellent and amusing reading matter; but this particular paper relates simply to the days of 1881 to 1884, and covers, of course, only a few such actual facts as befell the writer.

There is no question but that in the infancy of the subdivided or incandescent electric light the first cost was more of a luxury than otherwise. While the operation of the plant (I refer more particularly now to "isolated plants") could easily be shown, by simple arithmetic, to cost materially less, including even the interest on the investment, when compared with the cost of gas, at the prices the latter commodity was selling for 12 years ago, at the same time a sale of goods required much persuasion and many visits to the customer. If it is borne in mind that a 60-light incandescent dynamo at that time was as expensive as a 300-light one is to-day, one can readily appreciate the statement made above, and also obtain an idea of the remarkable results brought about by competition and time. Not only were dynamos expensive, but the lamps and sockets also were scheduled at five times the present prices. Sixteen-candle power lamps cost $1.25 each, and the guaranteed life was no greater than it is to-day at 30 cents. Key sockets were $1 each, and were not so well made either as the socket selling to-day at 20 cents.

To tell the truth, these prices did not stand for many years; furthermore, the business transacted was exceedingly small for the first two years, considering the capital invested and the vast expense always accompanying the introduction on a broad scale of any new but practical invention.

Thirteen years ago one of the first private houses wired for electric light (Edison system) was that of Wm. H. Vanderbilt, at New York. As the house was of ample proportions, and the owner had no particular reason for "reducing expenses," the number of lights of 16-candle power each for which the building was wired was in the neighborhood of *nineteen hundred*. Imagine a bunch of No. 10 wires (each about an eighth of an inch in diameter) as large as 3 inches in diameter leading from the house to the street, for the "mains," and you may conceive something of the enormous amount of current at 110 volts which it was anticipated would be required when the entire house was illuminated. If I remember the figures correctly, there were 5 *tons* of copper wire utilized in the wiring of this residence. The mains were prepared for connecting to the street and from thence to the generating station, when the latter was erected, which was not until several years had elapsed. For immediate use it was arranged that a small isolated plant should be placed in the basement and immediately under the covered passage connecting this residence with that of Mr. Twombly's.

The plant was so small that not more than 120 lamps out of the entire 1,900 could be utilized, and it consisted of a locomotive boiler, designed by the writer, and built by the Baldwin Locomotive Works, and a pair of Armington & Sims engines connected by belting to a countershaft, which, in turn, was belted to two Z dynamos, each of 60 lights capacity.

On a certain evening the Vanderbilt family came to the house, when everything was in readiness, to witness the illumination of the halls and various rooms. This arrangement called for several of the representatives of the Edison Company to be "on deck" to see that the exhibition became a success in all respects, as the criticism of such a family meant, if favorable, much business for the electric company, and, if unfavorable, exactly the reverse, but in a far greater degree. One of the earliests "kobolds" which ever came to my notice made its appearance on that evening. On the second floor, fronting Fifth avenue, there was a large room handsomely decorated with "cloth of gold." This material covered the walls in a manner similar to that of wall paper. On the sides of the room there were several combination gas and electric brackets. The ceiling contained quite a number of single electric pendants distributed around the four sides. The combination fixtures also were wired for lighting the gas by electricity.

For some unknown reason this room had not been previously tested by the current from the dynamos, and the accident which occurred was all the more surprising to those who were present. There must have been a "short circuit" from one of the brackets to the wall plate which came in contact with the fine threads of gold which were woven in the cloth covering the walls and ceiling. One of the pendants above was similarly short circuited. When the switch was closed a streak of electricity shot from the bracket in a zig-zag fashion to the ceiling, and as long as the switch remained closed the current would take new paths among the metal threads, leaving behind it a disfigured wall. From a scientific standpoint the effect was most brilliant and vivid. The scene only lacked the thunder furnished by the "property man" to make one think of the stormy night which Rip Van Winkle had to face when he was driven away from his home. From the bracket to the floor the covering on the wall was parted in a perfectly straight line, and the edges were as clean and smooth as though they had been cut with a knife specially sharpened for the purpose. Of course this room was kept locked after the above performance, and the family did not see it illuminated. It cost the Edison Company a pretty penny to make the necessary repairs, although there was considerable doubt about their being the only ones who were responsible for the bad work; directly, however, there could be no question about the accident resulting from the Edison current.

Unfortunately, Mrs. Vanderbilt had no particular fancy for residing immediately in the vicinity of a steam engine and a boiler carrying 120 pounds steam pressure, not taking into consideration the "hum" of the machinery, which was indispensable, and that evening's exhibition concluded the farce of the Edison-Vanderbilt combination with the ordering out of the entire plant.

The continuation of the outfit would only have resulted in its being used as a plaything, for 120 lamps would scarcely illuminate the ballroom or art gallery.

It was quite customary for the Edison Company to keep its "eagle eye" on all new buildings under course of construction, and among those which were fairly well along in 1883 was the "Eden Musee," at New York, containing the well known wax works collections. Just what it was intended to be used for was scarcely understood by the majority of persons who watched its progress, but it shortly became known to the Edison Company that the owners contemplated lighting it with many thousand gas jets. Here was a golden opportunity for the Edison Company to sell these people some money, for could it not be mathematically demonstrated that by using the electric light the cost of same would be far below that of gas for the same candle power hours? After interviewing the foreigner in charge of the work on behalf of the Eden Musee Company, who could scarcely speak English, it was discovered that he had an abhorrence for "ze electric light," and pronounced himself as being unfavorably inclined to consider the matter in any manner whatsoever. This was very good for the first lesson, but we were not to be downed so easily. The next interview with this party elicited the information that he had tried this method of illumination in a house abroad, and it was so defective that nearly all the wax works were spoiled—the light was so ghostly. After many protestations by the writer to the effect that he surely was mistaken, and that *our* electric light was altogether different from the kind the gentleman referred to, I was most emphatically informed that he knew an electric light when he saw it, and that there was only one kind. After much discussion, in which you will see that my French failed me entirely in endeavoring to make myself understood, the inquiry was launched at my head as to the cost of *one light* to be placed outside for an advertisement.

To think that the result of all my endeavors with this party, with a view of educating him to appreciate and understand the incandescent lamp, should only prove that he had but one idea of an electric lamp, and that was the kind "out in ze square," as he described it—an arc lamp! While there was no love about my discussion with him, there certainly was much *labor lost*. I afterwards found that this French gentleman was not the manager after all. The latter party arrived in New York a short time after the above discussion occurred, and to him I repeated the story of what we desired to do and why. I found Count Sartere, the manager, a very amiable person, and had no difficulty in demonstrating to his entire satisfaction that the Eden Musee would be a failure without the Edison light. If the Chamber of Horrors was to be illuminated by gas jets it would certainly become so foul a place that the name would not be a misnomer.

The success, from an illuminating standpoint, of this resort has been superior to any other similar institution hitherto constructed by the Eden Musee Company.

A good story is told of the competition between the representative of the Brush Electric Company, Major ——, on behalf of the arc light, and the Edison Company's excellent advocate, Mr. B., for the lighting of a certain factory not far from New York city. These gentlemen called on the same day to present their respective claims to the owner, who was a German, as to why the "other fellow's" system would not be suitable for the purpose. Of course, the Major argued that his arc light was very much cheaper to operate, and the purchaser would obtain

thousands of candle power in excess of the incandescent lamps and for less money expended in the first cost. Naturally Mr. B. contended that the owner could not use the arc lamp, because it "flicked" so badly that the employees would be seriously hampered in their work, which required the very best of illumination, and the Edison system could be so utilized that each employee could have a lamp immediately under his or her control, and as for operating expenses, "it was far cheaper and safer than gas."

"Vell,' said our German friend, "dat's pooty good, too; you shust draw me up dose babers and I giv you der order in der morgen."

Joyfully our friend Mr. B. wended his way towards the finest hotel which the town was guilty of supporting, stopping in the telegraph office on his way to announce the glad tidings to the home office, and advising them that the particulars would be sent later. Little did he imagine that the particulars which were to be given later would be carried in person, and be of a very different nature from that implied in the message. Mr. B., after having handsomely taken care of the inner man, lighted one of the good cigars which he was always well supplied with, and proceeded to draw up the formal proposition, specification and contract. How contented he was, laughing at times as he thought of how well the Major had been tricked out of that plant—and anyone who could thus "do him up" must be a particularly competent party, for the Major was no fool. To say that Mr. B. slept well that night would not be doing him justice.

And what of the Major? Did he take the first train home that evening vowing vengeance on B.'s head? Not he. After darkness made its appearance, if I may be pardoned such an expression, he sought the German gentleman and invited him out to investigate certain facts pertaining to the arc lamp as it appeared on the street corner. The result of this investigation may possibly be told to better advantage by relating the experience of Mr. B. on the following morning. That gentleman was up betimes, bright and early, prepared with all the necessary documents, and forthwith hied himself to the office of our German friend, as per special appointment. The office boy presented Mr. B.'s card to the proprietor, who sent word out that he would see him in a short time. After waiting much longer than the "short time," our incandescent contractor concluded that he had been forgotten, and said to the boy, "Tell Mr. B. that I had an appointment with him for 8:30 this morning and it's an hour after that time now. I would like to get through with my business and go back to New York."

The boy disappeared, and in a few minutes who should walk out of the office but the Major. In meeting Mr. B. both gentlemen were particularly affable toward each other. One because he had a signed contract in his pocket, the other because he doubted not the promise of the purchaser who had invited him the previous evening to call in the morning and he would "giv him der order."

The proprietor greeted Mr. B. in a somewhat sheepish manner, and the following conversation ensued:

Mr. B.—"Agreeable to the appointment made last evening I have called this morning, and here are the papers covering my proposition. Will you please look them over?"

Mr. Propietor—"I vas very sorry, aber I cannot do any pisness mit you."

Mr. B.—"What do you mean, sir? You promised me the order this morning, and I have already telegraphed it to the works in order to hasten the delivery as much as possible. Do you mean to break your word?"

Mr. Proprietor—"Vell, I did exshpect too geep my vord with you, but shoost after you left me last evening de oder fellew he come und showed me dot you toll me a pack of lies aboud dot big lamp. He say his lamp no flicker for my pisness."

Mr. B.—"Mr. Proprietor, you have been duped, and have also played me false. You saw the lamp in the street flickering, and that's just what you will get in your mill. Do you mean to tell me that the Major guaranteed his lamp would not flicker?"

"Ya, und I toll you how it vas. Der Major und me took a valk last night after you lef me und we shtopped by der lamp on der shtreet corner. Der Major said it vas all nonsense dot you said aboud dot lamp flicker and dot der engineer he make em flick for pisness like advertising. Peoples going by would nothing notice when dot lamp geeps quviet, und when dey see him flicker dey look up und see der name Brush on der lamp. Und Major proved dis too by tooking oudt his vatch und say, 'now, he flicker efry vier seconds—there, see him flicker—in vier seconds he flicker again if dot engineer is doing his dooty,' und he did flicker. Aber I doan want any flicking lamps, so der Major say he make der engineer geep em quviet und die brice is scheaper as yours so I giv der Major der order."

Wearily, but not crestfallen, our friend Mr. B. wended his way back to New York, and since this experience he has no doubt come to the conclusion that "one is never so sure until he is for certain."

As he is still selling electrical goods, and excellent ones too (the kind which elevate), there is no question but that he has lived to have his revenge by making good use of his early experiences and practising occasionally upon his competitors.

One of the best known men in the electrical field told me recently of the manner in which he evaded a very serious question, put to him in the infancy of his electrical experience, and when he did not know an armature from a boot-jack. The competition this time was between the Brush arc dynamo and a Thomson-Houston. The representative of the former had advised the purchaser that the Brush machine had separate bobbins wound on the armature in such a manner that any one could be repaired in a very short time by simply rewinding that particular bobbin without interfering with the others, whereas the Thomson-Houston armature was complicated that if any wires should become defective, which were several "layers" down, the whole exterior would necessarily have to be removed. When my friend who represented the Thomson-Houston Company was asked to explain this apparent defect in the construction of their armature he was non-plussed for a reply, as he had never seen both armatures together, and at that time did not know anything about the construction anyway, in fact was a greenhorn as far as detail was concerned. After hesitating a few minutes he replied (I wonder what particular God he worships?) that an explanation was very easy. The Brush dynamo was expected to and actually did burn out very frequently, hence provision for taking care of such an abominable occurrence, while the Thomson-Houston never burned out. In fact, owing to the design that was impossible and therefore the company had no need to arrange to take care of rewinding. For this brilliant piece of truth (?) the Thomson-Houston party received the order for the plant.

To say in general that members of the electrical fraternity still have to resort to very peculiar methods at times in order to secure business, and that merit is not always the basis on which contracts are secured, probably expresses the feelings of many persons in that line of business; but thanks to the now general and frequent electrical "squibs" which appear in the best class of newspapers, and the many notes pertaining to the same subject which are printed in the magazines, the general public is not so apt to be "taken in" as was undoubtedly the fact in the early days of the electrical business.

The Gas Manager in Bombay.

In a series of articles, appearing in the *Gas World*, on the subject of the "Gas Manager Abroad," by Mr. Henry O'Connor, Mem. Inst. C.E., the author remarks, among other things, that there is very little doubt that many places might be found in India where a gas works could profitably be erected and carried on; but the capital must be found in England. The native is, unfortunately, of a very conservative nature, and unless he has been in Bombay or Calcutta, where gas works are being successfully carried on, he has no means of obtaining a knowledge of the advantages to be obtained from the use of gas. Many of the native merchants, and others, have large reserves of capital, but they must be well assured of the success of a project before they will invest their money to carry it out.

Prospects of the Industry in India.—The capital of the Europeans living in India is already fully occupied, and the only way, as before stated, is for the capital to be found in England. Karachee, a large and flourishing port on the northwest coast of India, and in the Persian Gulf, is one of the towns where a certain portion of the inhabitants are anxious for a gas works to be started. In fact, the project was several times mooted; but the necessary capital not being ready in the town the matter was shelved for a time. Goa, the capital of the Portugese settlement, has also been considered as a paying center for gas distribution, and a very fair proportion of the capital of the necessary company was at one time promised among certain Bombay natives.

One difficulty which lies in the way of the extended use of gas in Indian towns is the large gardens or "compounds," and the consequent distance apart of the better class houses. The distance of the house from the road also being great, the cost of the individual supply is made much higher. It is this difficulty that has been the stumbling block in the way of the adoption of gas as the lighting agent in Madras, a large and influential city covering a very extended area, with many fine public buildings and Government offices. The only gas works in the town is a very small one, for the supply of the soldiers' barracks.

Another great difficulty in the extension of the use of gas is the fact

that the native usually lives in a one room "chawl," or shed, or else in one room of a series of flats. Again, the low rate of wages leaves the native unable to pay for anything but the most meager rushlight; the common method being to purchase about a farthing's worth of cocoanut oil, and with a small piece of cotton wick floating upon this in half a glass of water, obtain a flickering flame not giving as much illumination as an ordinary night light. A high illuminating power is not required, as only a very few of the natives can read or write, and they retire to sleep, or to put it more correctly, they lie down to sleep, very shortly after sunset, except when they are celebrating a wedding or singing a dirge for their dead, when they congregate around a small flickering light and bang drums and cymbals far into the night, to the annoyance of the European who is anxious for sleep.

The fact that the native families occupy only one small room does not necessarily mean that the whole family sleep there. Except during three or four months in the year, when the southwest monsoon, or rainy season, is on, the whole of the poorer portion of the native population is to be found sleeping on straw mats, lying in the open, often in the middle of the roads, with a piece of calico wrapped around them in the form of a sheet; it being no unusual occurrence, when driving home after dinner, to have to send one's coachman on ahead to awaken those sleepers, and make them get up and remove their beds to allow one's carriage to pass.

Take Care of the Insects.—The principal native houses usually consist of one very large room, used mostly for ceremonies, and a goodly number of smaller rooms, in which the family reside in the usual way; consequently the quantity of gas used is not very great, considering the size of the house, the smaller rooms not being considered sufficiently large or important to warrant the expense of the fittings for gas supply, while the large room is only occasionally used. These latter are usually fitted up with glass chandeliers with crystal pendants, a form of gasfitting which the native seems very fond of.

A point which might be mentioned here is the difficulty of guarding the gas lights from the great number of insects which are naturally attracted to it. The necessity of doing this arises from the religious scruples of the high-caste Hindoos, who believe that the souls of the dead pass away through the different grades of animals, down to the smaller insects; hence their horror of assisting in shortening the life of any insect. In fact, I have known large contracts to be lost owing to the unthinking action of removing and, at the same time, killing insects which happen to fall upon the paper which was being examined.

In Bombay the whole of the gasfitting in the town is done by the Gas Company, who keep a very large stock of fittings, etc., in their "godowns" or stores. The staff of gasfitters is therefore necessarily a large one. The native becomes in time a very fair gasfitter, but only after considerable training. They usually come into the workshops as boys 17 or 18 years of age, and gradually learn the work there; this work being of a very varied nature, embracing, as it does, the making and repairing of meters and the re-arranging and re-lacquering of fittings, and, in a large number of cases, the manufacture of simple fittings in iron, such as harp and swan-neck pendants, also the manufacture and repair of the street lanterns. The large-sized meter drums are sent out from England ready marked, and are put together on arrival. After serving some considerable period in the shops, the men go with a more experienced gasfitter out upon the district, and there gradually learn the methods of fitting up houses and shops. The small shops are usually considered sufficiently lighted with a swan-neck pendant; and, of course, each one requires its own meter, which is always of the wet type. Owing to the deterioration of the leather diaphragms by the heat, dry meters are never used.

Street Lighting.—Possibly a reduction in price would cause a considerable increase in the consumption, as the very low price of Russian petroleum causes that and the native-made cocoanut oil to be very serious competitors of gas. The streets, however, are nearly all lighted by the ordinary gas lantern, fixed either in brackets or on the usual iron column, a few of the by-roads on the outskirts only being lighted with paraffine oil lamps. Curiously enough, the barracks are not lighted with gas, this being possibly accounted for by the fact that when the barracks were first fitted up the gas mains did not extend to the end of the island where the soldiers' quarters are situated. The number of public lamps may be imagined when it is stated that from 35 to 40 lamplighters were employed, who were required to run while lighting. They were all provided with a uniform, for the purpose of identification.

Electric Light.—The electric light, except on the very fine docks, was practically unseen in Bombay. It is true that a company had been started and had worked for some little time lighting a few of the roads about Malabar Hill, which is the Belgravia or Mayfair of the city. Here were a few arc lights, which occasionally took it upon themselves to go out just as the principal inhabitants were driving home to dinner. But the company died a natural death, and some few years ago the only places lighted by electricity were the Yacht Club and a series of large flats erected near it by the Sirdar, who had formerly been in the Nizam's service as chief police officer. It might be thought that electric lighting had a good future before it in a hot climate; but the rooms lighted by it seemed no cooler, if as cool, as those lighted by gas. All the windows and doors are wide open, and possibly the heat of the gas induces a draught, in some slight degree, which is always welcome in tropical countries. There is little doubt that a ventilating regenerative lamp would prove the best arrangement, as this would enable the warm, vitiated air to be carried away into the open air. But possibly the incandescent gas burner, which is being largely adopted there, will be an improvement over the union jet; it certainly has the appearance of a cooler light.

Opening for Water Gas.—There is very little doubt that before long the question of water gas plant for use in India must be thoroughly discussed. The low price at which petroleum can be obtained there should favor the adoption of such plants, at least in the form of an addition to the coal gas plant. Coke, it is true, fetches a fairly high price; but the arrangement with the municipality, under which many of the public lamps are extinguished about the time of the full moon, has always proved a very difficult thing to deal with, settings having to be put on and taken off each month—a practice which soon brings them to such a state that they are unfit for use until thoroughly repaired. Here, then, would be found the advantage of a small water gas plant, which might be used only on such days as all the street lamps were to be lighted, keeping the same number of retort settings continuously at work. The necessary lighting up would take but a few hours, and the wear and tear of the apparatus would be a mere nothing as compared to that of a setting for coal gas.

Market for Residuals.—As just mentioned, coke and breeze realize very good prices, being used for brick making and lime burning, while the Great Indian Peninsular Railway take a certain quantity, in wagons, for use in their locomotive and carriage workshops, which are no great distance from the gas works. In the matter of railway accommodation the gas works are exceedingly well situated, being located with the main line of this Great Indian Peninsular Railway running the whole length of one side of them, a siding being provided for the sole use of the Gas Company. With respect to the sea, however, the gas works might have well been better placed, as the sea is some distance off, causing a considerable journey for the bullock carts when travelling to and fro with the coal.

Sulphate of ammonia is not manufactured in Bombay, owing to the great cost of sulphuric acid; indeed, the price asked for this latter commodity was more than could have been obtained for the article it was proposed to manufacture by its aid, and this was the case despite the fact that a factory for making sulphuric acid was in full working order within a few yards of the gas works. Unfortunately, so far as the sale of sulphate of ammonia is concerned, the soil of India is very fertile, and, owing to the warm sun, after the heavy rain of the southwest monsoon, it becomes very light. The decomposition of the vegetation which has grown up during the rainy season, and which has been dug into the earth, makes it so rich that very little, if any, manure is required. Then, again, the farmers are not rich, each man owning but a field or so, and consequently no systematic or scientific farming is carried on. If, however, sulphate of ammonia could be manufactured at anything like a moderate price, there is little doubt that among the many European coffee, tea and indigo planters, whose property lies on the other side of India, a ready sale could be effected. In fact, on more than one occasion inquiries were made as to the price at which sulphate could be delivered into trucks on the railway.

Getting Customers.—With regard to the extension of the use of gas among the poorer classes of the native population, there is very little doubt that a fair proportion of them might be tempted by means of the penny-in-the-slot system, although the quantity of gas which could be given for the anna piece, which is about the same size as a penny, would be somewhat small, as, allowing for rent of the fittings and meter, and probable quantity of gas consumed, at least one rupee per thousand cubic feet extra would have to be charged, and something like 10 cubic feet only could be sold for the anna, which is, at the present rate of exchange, rather less in value than one penny. The system of giving a commission for all new consumers brought in is in force, and a very fair amount of new work is to be attributed to it. One or two men who are employed in this way often bring in orders for illum-

inations for weddings, which, without their assistance, might have been carried out with oil lamps. They keep themselves in touch with the native community, and so learn when any celebration is about to take place. The system of hiring fittings is carried on to a considerable extent, many Europeans, who perhaps are not certain of the length of their stay in the country, preferring this method to purchasing the chandeliers, etc., outright, and selling them when leaving. The same system is also largely employed by the furniture dealers, only a very small proportion of the European population being the real owners of the furniture which is to be found in their houses. Among the Government officials this is nearly always the case, as they are liable to be shifted to another corner of the Presidency at very short notice.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. John R. Lynn, under whose careful management the Penn Yan (N. Y.) Gas Light Company has moved on to greatness and dividends, has resigned the dual position of Secretary and Superintendent, and we are more than sorry to have to say that his action is the result of ill health. He hopes, as do we all, that a few months of complete isolation from all business cares will bring to him renewed strength and all of his old time vitality. The Company, on receiving his resignation, took the following method of testifying its appreciation of his work:

"*Whereas*, The Directors of the Penn Yan Gas Light Company have received the resignation of Mr John R. Lynn as Director, Secretary and Superintendent of the same, to take effect January 1st, 1895; be it

"*Resolved*, That his resignation be accepted, with an expression of our goodwill and esteem, and regret that he finds it necessary to sever his connection with the Company; be it

"*Resolved*, That a copy of these resolutions be forwarded to Mr. Lynn, to the American Gas Light Journal, and to Progressive Age.

"I Morgan D. Tracy, 2d, Secretary pro tem of the Penn Yan Gas Light Company, do hereby certify that the foregoing is a copy of a resolution passed at a meeting of the Directors of the Penn Yan Gas Light Company, held at the office of the Company, in the village of Penn Yan, N. Y., on the 22d day of December, 1894, and of the whole of such resolution. Morgan D. Tracy, 2d."

"Dated December 22d, 1894."

At the annual meeting of the shareholders in the Metropolitan Gas Light Company, of Brooklyn, N. Y., the Directors chosen were: Messrs. A. E. Orr, E. R, Chapman, U. H. Curtis, C. H. Stoddard, A. F. Staniford, R. D. Trimble, G. H. Prentiss, L. W. Stockwell, W. J. B. Mills and L. B. Powell. The only members on the new Board who served last year are Messrs. Orr, Stoddard and Staniford, a fact which goes to show that the new owners of all the Brooklyn Gas Companies are preparing to assume actual control of the properties.

A correspondent at San Francisco, writing under date of December 22d, says: "Just after the payment of its quarterly dividend last April, the works of the Capital Gas Company at Sacramento were partially destroyed by fire, the electrical department being the one which suffered most. The damage was considerable, but the Trustees at a special meeting resolved on levying two assessments of $5 per share to cover the loss and rebuild the damaged works. This meant the payment of $100,000 by the stockholders, which was a heavy and unexpected burden; and no Gas Company on this coast had ever before been obliged to impose such a tax on its stockholders. The assessments were paid and the plant restored and improved very much in every way. The Company has now seen its way clear to resume the payment of the former modest dividends, which were at the rate of $1 per share every three months. A dividend of that amount will become payable on January 2d; and it will be much appreciated by those who did not lose their faith and their stock in the day of trial."

The corporate title of the Fort Dodge (Ia.) Gas, Electric Light and Power Company has been changed to that of the Fort Dodge Light and Power Company, and the capital stock has been increased from $50,000 to $125,000.

Messrs. David Banks, Alex. C. Robertson and Chas. W. Comstock have filed, in the office of the Secretary of State of Connecticut, a petition to the incoming Legislature for the incorporation of the Banks Gas and Electric Company, of New London.

The regular quarterly dividend of 1½ per cent. has been declared by the proprietors of the New Bedford (Mass.) Gas and Edison Light Company. It is payable on the 15th inst.

At the annual meeting of the shareholders in the Ilion and Mohawk (N. Y.) Gas Light Company, the officials chosen were: Directors, Thomas Ringwood, C. W. Carpenter, A. N. Russell, A. E. Brooks, John Hoefler and John V. Schmidt, of Ilion; H. D. Alexander, of Mohawk; and W. I. Taber, of Herkimer; President, Thomas Ringwood; Vice-President, John Hoefler; Secretary, John V. Schmidt; Treasurer, C. W. Carpenter.

The Naugatuck Malleable Iron Company, at Naugatuck, Conn., has placed the contract for its new annealing room with the Berlin Iron Bridge Company, of East Berlin, Conn. The building, the dimension of which is 94 feet wide by 175 feet long, is to be entirely of fireproof construction.

The following letter explains itself:

Capital City Gas and Electric Light Co.,
Frankfort, Ky., Dec. 31, 1894.

To the Editor American Gas Light Journal: Seeing in a recent issue of your Journal that a Colorado Company had closed a contract for a set of improved Lowe apparatus, I wondered if the Company were prepared for the radical cut in consumption that will take place when the gas from the new process is turned on, under exactly the same conditions regarding pressure, candle power and burners. For the past five years the plant in question has been operating a double set of water-oil apparatus, under the patents of Mr. Leon P. Lowe, which plant superseded an old-style coal works. Being on the grounds, when the oil works was built and the gas turned on, a large increase in the bills was noticed by the writer before any change was made in either the burners or pressure—and this in the face of the fact that the average candle power of the new gas was about 21, as against a candle power of about 19 for the product of the coal benches. This phenomenon occasioned some surprise on the part of the management, and a great deal of comment on the part of the consumers, which, could the same have been analyzed, would have shown a heavy percentage of sulphur compounds; in other words, they made the air blue. It was decided the change was caused by a difference in the gravity of the two gases, but it was not so proved at that time. A remedy was applied in the shape of smaller tips, which helped matters more or less. Since taking charge of this plant the writer has had an opportunity to demonstrate that there is a difference in gravity; but whether this accounts for the difference in consumption altogether the writer has not been able to determine, having been unable for the lack of proper apparatus to make any analytical test. Our plant here consists of two sets of old style, single shell Lowe apparatus and a set of the Kendall oil apparatus. Upon taking charge the writer found that this Company was having the same experience with large bills, having just commenced to operate the Kendall works, conditions as to candle power, burners and pressure being the same. Having a bar photometer, and keeping an accurate record of the two gases (Kendall and Lowe), covering a month at a time, the average candle power maintained was found to be about 22.5. The gravity was obtained by means of Schilling's effusion tests, and the average was found, for the Kendall, to be, .376, while that of the gas made by the Lowe sets was .526, showing a difference of 15 per cent. In actual practice the difference in consumption, when the two processes are alternated, is fully as great as this, if not greater, we having found a difference of 10,000 cubic feet per day on an average output of 45,000 cubic feet. We use about 50 lbs. of anthracite coal and 4½ gallons of Lima crude oil in making the water gas, and an average of 10 gallons of the same oil in making the gas by the Kendall process, no air being admitted to the generator. I should very much like more light on this subject, and would like to hear from others who have had the same experience, if you consider the matter of any moment; if not, I regret having taken up your valuable time. Yours very truly,

E. C. Hathaway.

The new power station for the United Electric light and Power Company, on West 28th street, this city, is now being put in place by the Berlin Iron Bridge Company, of East Berlin, Conn. This will be a model station, and one of the most complete and perfect in the Eastern States. The engine and dynamo-room is 100 feet square, and the boiler-room is 60 feet by 100 feet. The roof covering on the dynamo-room is to be of the Berlin Company's patent anti-condensation corrugated iron. The coal pockets in the boiler-room will have a storage capacity of 3,000 tons.

A correspondent at Quebec forwards the following: "On December 27th, the important question of the assessment of gas mains in Hamilton came before Judge Muir, of that city. The Hamilton Gas Light Company appealed against its mains being assessed for $85,000

by the Court of Revision. The assessor originally placed the amount at $125,000, but it was reduced to the former-named amount by the Court. There are about 25 miles of mains under the city streets. Manager Littlehales, of the Gas Company, estimated the value of the pipes as old iron at $5,817, and he said it would cost about $74,900 to replace them with similar new mains. Assessment Collector Balfour said that the City Council passed a resolution in 1880 exempting from taxation machinery and plants used for manufacturing purposes, but he did not regard gas pipes as machinery or plant. Mr. E. Martin, Q. C., argued that the gas mains should not be assessed where the poles and wires of the Electric Light Company were not assessed. Those Companies simply paid a certain sum to the city for the privilege of a monopoly. Justice Muir held that gas mains were real estate, and although he reserved his decision, he intimated that he was inclined towards the city's side of the case."

A SEMI-ANNUAL dividend of 4 per cent. has been declared by the proprietors of the Hartford (Conn.) City Gas Light Company, payable now.

AT the annual meeting of the Eastport (Me.) Gas and Electric Company the officers chosen were: Directors, T. T. Robinson, E. A. Holmes, Joseph Anderson, S. D. Leavitt, F. S. Paine, Alden Bradford, and J. J. Pike; President, Joseph Anderson; Clerk and Treasurer, N. B. Nutt; Superintendent, S. D. Leavitt.

A RATHER astonished man was Mayor Strong, of this city, when he first learned that one of the personal perquisites of his office was the right to have two street lamps in front of his private residence. This, says the *World*, has been the custom almost from the days of Peter Stuyvesant, but about two years ago it was put in the form of an ordinance, and was made applicable to ex-Mayors as well. Superintendent McCormick, of the Bureau of Lamps and Gas, informed Mayor Strong of the ordinance, and our chief executive officer was so nonplussed at the news that his reply was he "would consult with his wife about it," and inform the Superintendent later as "where he would have the lamps placed."

AT the annual meeting of the Auburn (N. Y.) Gas Company the officers chosen were: Directors, E. H. Avery, James C. Reed, D. M. Dunning, O. F. Knapp, S. E. Payne, H. S. Dunning, W. E. Hughitt, D. A. Smith and N. B. Eldred; President, E. H. Avery; Vice-President, James C. Reed; Secretary and Treasurer, D. M. Dunning.

WE regret to announce the death of Captain Frank Stein, Secretary and Treasurer of the Newport (Ky.) Light Company, whose demise occurred on the evening of December 28th, at his home, 1018 York street, Newport. Deceased had for many years been prominent in steamboating on the Ohio river.

A CORRESPONDENT at Washington, D. C., forwards the following respecting gas matters at Alexandria, Va., the gas plant at which point is owned and operated on municipal account: "The special committee, composed of the committee on light, finance, and general laws of the City Council of Alexandria, Va., to whom was referred the proposition of the Atlantic Gas Construction Company, of Philadelphia, to lease the city gas works for 99 years, will probably meet this week. Meantime the subject has been and is being generally discussed. When asked what he had to say upon the subject, Mr. Charles King, of King & Son, wholesale grocers, replied: "'I am decidedly in favor of leasing the works, for it will only be a question of a year or two before $20,000 or $25,000 will have to be spent to replace the rotten mains.' Mr. King said also he was 'not now a consumer of gas, because I was once robbed by the gas officials, when, about 10 years ago, I paid to the city over $100 for one quarter's gas—$71.50 for my residence and $30 for my store. I would use gas, however, if I had any assurance that I would not be robbed again.' Ex-Mayor Downham said he was in favor of leasing the works. 'My experience,' he said, 'was, the lower the rates of the gas the higher the bills. Owing to the condition of the street pipes there is as much pressure of wind on the meters as gas, and there is a constant breaking of globes.' Mr. Downham also said that under the present style of management the consumers were paying for all the gas used by the city, besides a number of charitable and other institutions, and he believed that it would be much better to let a private company supply the gas. Ald. Noble Lindsey, who is a member of the finance committee, stated that he did not favor leasing the works under the terms offered, but preferred the plan of selling them for not less than $200,000. Of this amount he would use $150,000 for the purchase of outstanding city bonds, the balance to be expended in improving the city's streets. By such a sale and investment the present rate of taxes ($2 on the 100) could be reduced to $1.50 on the 100. Mr. Lindsey referred to the condition of the gas mains, and to the fact that since the gas rate was reduced from $1.80 to $1.50 per 1,000 cubic feet, every consumer had to pay bigger gas bills than before the so-called reduction. Mr. R. F. Tucker, of the George R. Hill Company, is in favor of leasing the works. Mr. French Smart, of the J. H. D. Smart Lumber Company, is in favor of leasing the works if the consumers can get better and cheaper gas."

ALD. MARRENER has introduced the following resolutions for the consideration of his colleagues in Chicago's Board of City Fathers:

"Be it ordained by the City Council of Chicago:

"Section 1. That all persons, firms or corporations now engaged, or who shall hereafter become engaged in the sale of illuminating or heating gas in this city, shall be required to place a stopcock or valve on the outside of each building which they are now supplying or shall hereafter supply with such gas, so that such gas may be shut off from said building or buildings on the outside thereof, and such valve or stopcock shall be of easy and rapid access to firemen, so that in case of fire or otherwise said gas may be shut off from said building or buildings.

"Sec. 2. Said persons, firms or corporations supplying such gas shall place the said stopcocks or valves in such building or buildings as shall be designated from time to time, by notice in writing to said persons, firms or corporations by the Commissioner of said buildings, but said Commissioner of buildings shall not direct, in any one day, any one person, firm or corporation supplying such gas to place more than 25 stopcocks or valves in buildings.

"Sec. 3. Any person, firm or corporation furnishing such gas in the city of Chicago, who shall, for 60 days after receiving such notice from the Commissioner of buildings, neglect or refuse to place such stopcocks or valves in the building or buildings designated and directed by the Commissioner of buildings, shall be subject to a penalty of $5, and to a further penalty of $5 for every day thereafter that said building or buildings shall be without said stopcock or valve, according to the provisions of this ordinance."

ABOUT a fortnight ago the Connersville (Ind.) Gas and Electric Company, incorporated by Messrs. H. M. Miller, Chas. E. Morse, A. M. Hudley, George W. Combs and C. F. Mosier, of Indianapolis, purchased the interest of Mr. J. N. Huston in the Connersville Gas Company. As the Company also owned the electric lighting interests of the city, the transfer means control of the gas and electric lighting supply of Connersville by the new concern.

IN the last week of December the plant of the York (Neb.) Electric Light Company was sold at sheriff's sale.

THE proprietors of the Muskegon (Mich.) Gas Light and Coke Company, which was chartered in 1871, report a fair trade for the year, not a small part of which is to be credited to the consumption on gas stove account, which department of the Company was given special attention during 1894.

THE offices of the Spencer (Mass.) Gas Company have been removed to spacious quarters in the Kent block.

THE offices of the Stockton (Cal.) Gas, Light and Heat Company have been changed to a floor in a building on Main street, between El Dorado and Center streets. The new quarters are greatly superior to those formerly devoted to the Company's counting and show-rooms.

THE people of Uxbridge, Mass., are complaining over the quality of the illumination resulting from their use of the electric lighting currents supplied by the Uxbridge Electric Light Company.

MR. JAMES FORREST, Secretary to the Institution of Civil Engineers, 25 Great George street, London, forwards "Greetings for Christmas and the New Year to all good friends in the United States."

THE Councilmen of Findlay, Ohio, are very much divided over the proposition to "ordain" an artificial gas company for that city, which proposition is backed by Mr. A. R. Whitely and other capitalists. The opposition seems to be based principally in the belief that such a company would cripple the natural gas concern owned by the city, although it is proposed to charge $1.25 per 1,000 for the artificial product.

The Market for Gas Securities.

Continued weakness was shown by Consolidated last week, the opening price to-day (Friday) being 127½, although towards noon 128 was bid. This is a loss of 3¾ points for the week and we fear the end is not yet. There does not seem to be any good reason why investors should fail to look the fact squarely in the face that the Legislature is disposed to cut the gas rate in cities of the first class to $1 per 1,000, and it is with that understanding that purchases of city shares should be made. Equitable is strong, at 180 to 183, as is Standard preferred, for which 88½ is bid. Mutual is also fairly well held. New York and East River common is steady, at 35 bid.

Brooklyn shares show no change, and everybody is now satisfied that the deal is a fixed fact. Chicago gas has had its ups and downs during the week, the shifting being made on the probability of the quarterly dividend being at the old figure or a lower one. We think the usual dividend will be declared. Bay State is weak, and Consolidated, of Baltimore, is also a trifle easier. The regular quarterly dividend (2 per cent.) on the shares of the United Gas Improvement Company is payable on the 15th inst.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

January 7.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	128	128¾
Central	500,000	50	105	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	180	183
" Bonds	1,000,000	—	107½	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	153	157
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	95	—
" Bonds	150,000	—	95	—
N. Y. & East River Gas				
Common	5,000,000	100	35	36
Preferred	2,000,000		48	50
Bonds	3,500,000	100	86	87x
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	40	41½
Preferred	5,000,000	100	88½	90½
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	120	—
Citizens	1,200,000	20	65	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	175	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	85	—
" Bonds (7's)	368,000	—	100	—
(6's)	94,000	—	98	100
Metropolitan	870,000	100	160	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	200	—
" Ctfs.	700,000	1000	99	100
Williamsburgh	1,000,000	50	200	—
" Bonds	1,000,000	—	107	110

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Wm. Cox, Stapleton, N.Y ... 3

COIN WRAPPERS.

Alvord & Co., Detroit, Mich ... 1

PATENTS.

H. B. Willson & Co., Washington, D. C ... 1

Situation Wanted

By young man, graduate of one of the leading technical schools of the country,

As Assistant to the Superintendent of a Gas Works.

Has a general knowledge of the gas business, and a thorough preparation in all the chemical work involved. Address

1022-4 "W. M. B.," care this Journal.

ENGAGEMENT DESIRED

By a thoroughly competent

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Satisfactory references. Address

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT COMPANY, 813 DREXEL BUILDING, PHILA., Dec. 27, 1894.

The Directors have this day declared a quarterly dividend of two (2) per cent. ($1 per share), payable on January 15, 1895, to stockholders of record at close of business December 31. Checks will be mailed.

1022-2 EDWARD C. LEE, Treasurer.

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Six Baltimore Retorts,

New, and in perfect condition, with Blocks to set in, an 8-foot Arch, "Cambridge Setting." Size, 14 in. by 28 in. by 9 ft. Address KINGSTON ELECTRIC CO.,

1021-3 Kingston, N. Y.

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A salesman and general office man of 25 years' experience, energetic, capable and reliable, and accustomed to handling specialties, desires to represent a manufacturer from Jan. 1st. Either wrought iron pipe, or supplies for gas, steam, water, and oil; or a line of gas cookers and heaters, oil stoves, etc. Large acquaintance among jobbers, retailers and consumers. All references. Address, "L. S.," care this Journal.

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Also Specials or Branch Castings, Lamp Posts of many designs, Gas Street Lamps, etc. Please write for illustrated pamphlet and for prices.

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Gas Governors,

Governor Gas Burners,

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In addition to a full assortment of Volumetric Governors, etc., I am now making **MERCURY PRESSURE GOVERNORS** of all the usual sizes, adapted to use upon *Gas Stoves, Furnaces, and Meters.* The same careful attention to details of design and workmanship which has established the reputation of **WILDER'S VOLUMETRIC GOVERNORS** will be given to the new line. They have been thoroughly tested in many places during the past year, and have given entire satisfaction. The price is very low, and but for a complete system of machinery adapted to this work, it would be impossible to sell them at the price. I hope for large orders, as they become known, in consequence of the low price and good quality.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

THE GAS APPLIANCE EXCHANGE,
20 S. Fifteenth Street,
Philadelphia, Dec. 28th, 1894.

To COL. W. E. BARROWS, G. M., Welsbach Light Co., Gloucester, N. J.:

Dear Sir—Owing to the severe storm of Wednesday night, which did so much damage to telegraph, telephone and electric light property in the City, I considered it would be well to examine the Welsbach lights in Rittenhouse Square. I therefore sent a man to make a critical examination of the lights, after they had been lighted the following night. It gives me great pleasure to state that of the 48 lights in the Square, not one was out of order or required repairing, all of them being in perfect condition, and showing no sign of being affected by the storm.

Very truly yours,

R. J. ROLSTON, Superintendent.

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Is Superior to All Others in

Economy, Safety, Durability,
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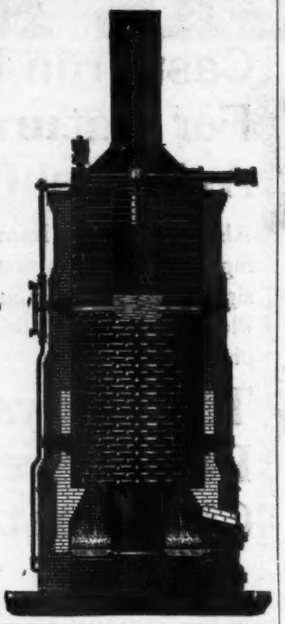
Quality of Steam Produced,
Combustion of Fuel,
Accessibility for Internal and
External Inspection and Cleaning.



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For Gas Purification.
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Gas Stoves,

PARLOR GRATES and RADIATORS, ASBESTOS BACK and ILLUMINATING FLAME STOVES.

Twelve new Heaters of beautiful design and finish added to our already large line for 1895, swelling the number of Reliable Heaters to

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Compare this number with any other two lines of Heaters on the market. Manufactured in all known styles and sizes, ranging in price from $4.00 to $26.00, and in finish from a plain iron to a full nickel or brass plated Stove. OUR NEW BRILLIANT RELIABLE No. 849 is by far the most beautiful Cylinder Stove ever offered the public.

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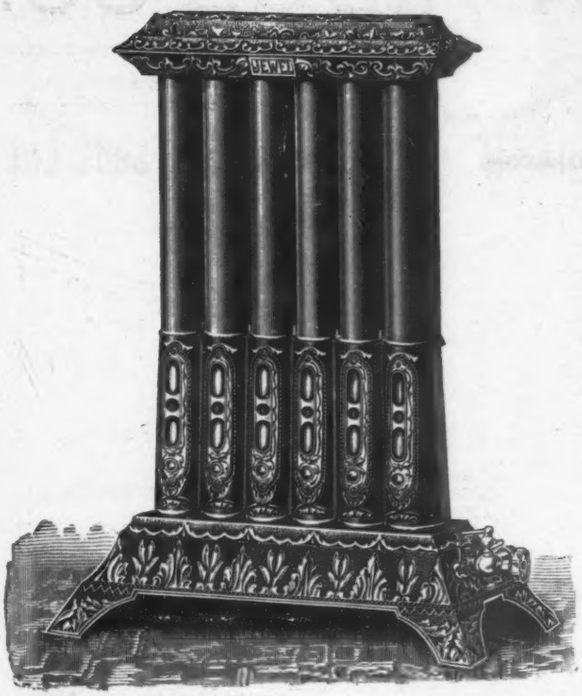
JEWEL GAS RADIATORS.



The Perfect Room Heaters.

If these Radiators were simply a duplication of what has been done, they would be worth but a passing notice.

One Continuous Tube Instead of a Single Tube Construction.
This gives greater burner capacity.

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This permits chimney connection, without extra cost in fuel.

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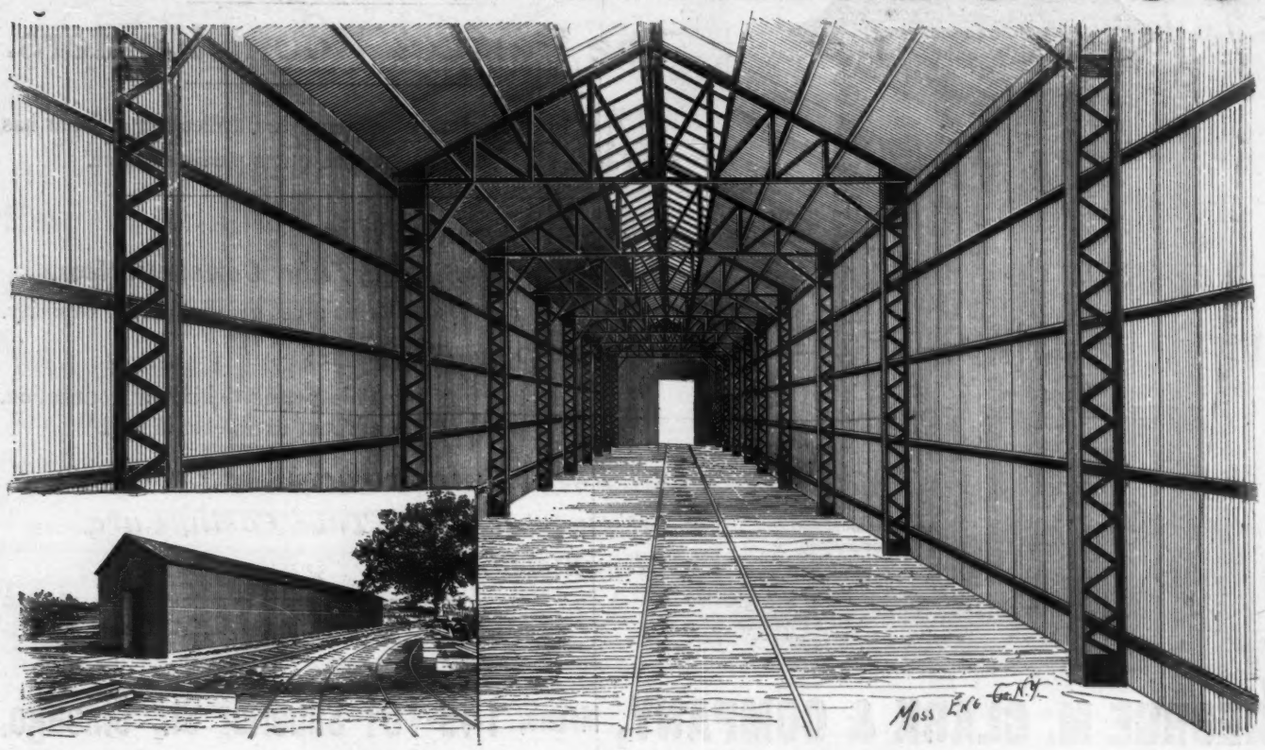

The above illustration is taken direct from a photograph, and is an interior view in a Store Room designed and built by us for our own use here at East Berlin. The construction particularly commends itself on account of the large amount of side wall space applicable for storage purposes, the light being introduced entirely from the roof, no side windows being used, thus allowing all the wall space for storage.

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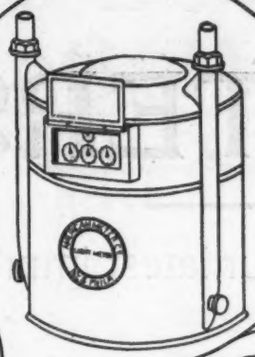

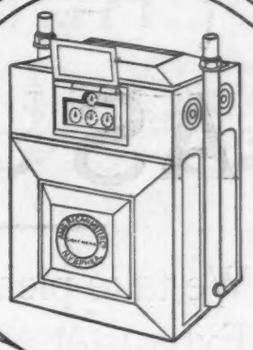

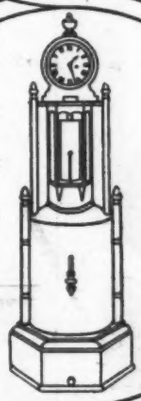

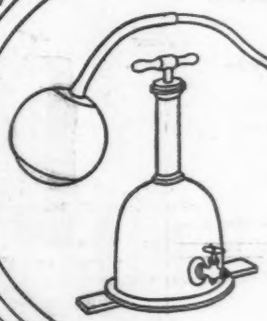

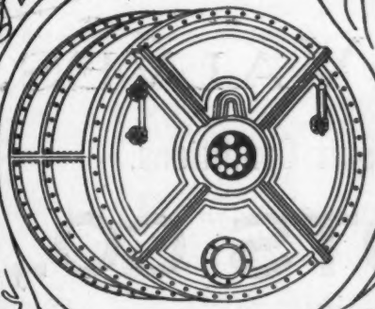

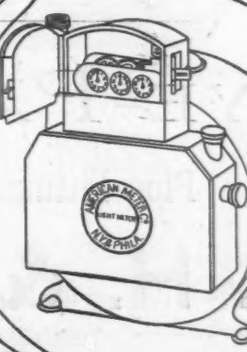

PUBLIC LIGHTING TABLE.

JANUARY, 1895.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	9.10 PM	6.20 AM	4.30	6.30
Wed.	2	10.10	6.20	4.30	6.30
Thu.	3	11.10 FQ	6.20	4.30	6.30
Fri.	4	12.10 AM	6.20	4.30	6.30
Sat.	5	1.20	6.20	4.30	6.30
Sun.	6	2.30	6.20	4.30	6.30
Mon.	7	3.50	6.20	4.30	6.30
Tue.	8	5.00	6.20	4.40	6.30
Wed.	9	No L.	No L.	4.40	6.30
Thu.	10	No L. FM	No L.	4.40	6.30
Fri.	11	No L.	No L.	4.40	6.30
Sat.	12	5.30 PM	7.40 PM	4.40	6.30
Sun.	13	5.30	9.00	4.40	6.30
Mon.	14	5.30	10.20	4.40	6.30
Tue.	15	5.30	11.30	4.50	6.25
Wed.	16	5.30	12.40	4.50	6.25
Thu.	17	5.30 LQ	1.50 AM	4.50	6.25
Fri.	18	5.30	3.00	4.50	6.25
Sat.	19	5.30	4.10	4.50	6.25
Sun.	20	5.40	5.20	4.50	6.25
Mon.	21	5.40	6.10	4.50	6.25
Tue.	22	5.40	6.10	5.00	6.25
Wed.	23	5.40	6.10	5.00	6.25
Thu.	24	5.40	6.10	5.00	6.25
Fri.	25	5.40 NM	6.10	5.00	6.25
Sat.	26	5.40	6.10	5.00	6.25
Sun.	27	5.40	6.10	5.00	6.25
Mon.	28	5.40	6.10	5.00	6.25
Tue.	29	5.40	6.10	5.05	6.15
Wed	30	9.00	6.10	5.05	6.15
Thu.	31	10.00	6.10	5.05	6.15

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45

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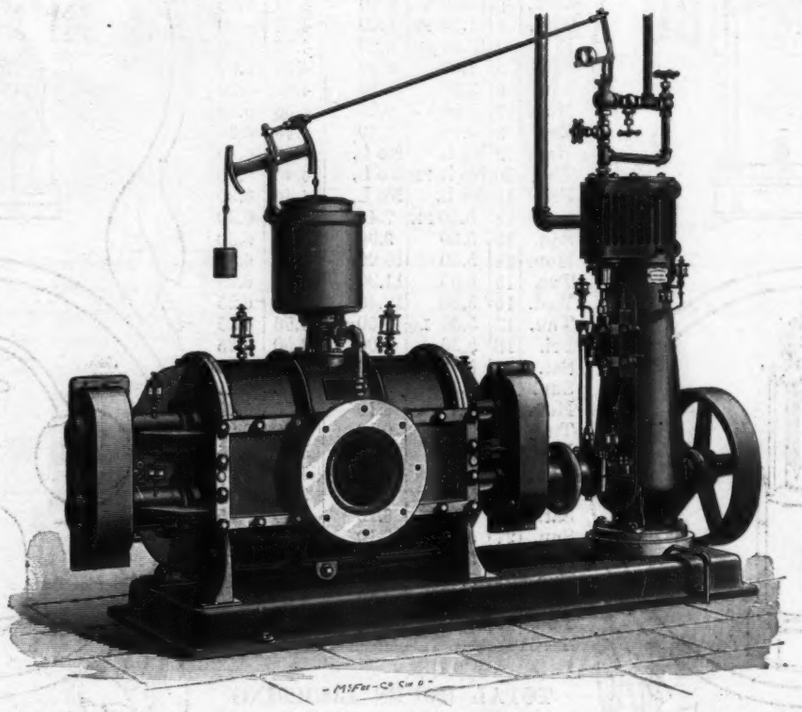
We take pleasure in illustrating herewith our latest improved Gas Exhauster.

It is without question the most perfect Exhauster ever constructed.

Our Latest Improved **Automatic Gas Governor** and **Steam Bye-Pass Valve** are the best in the market.



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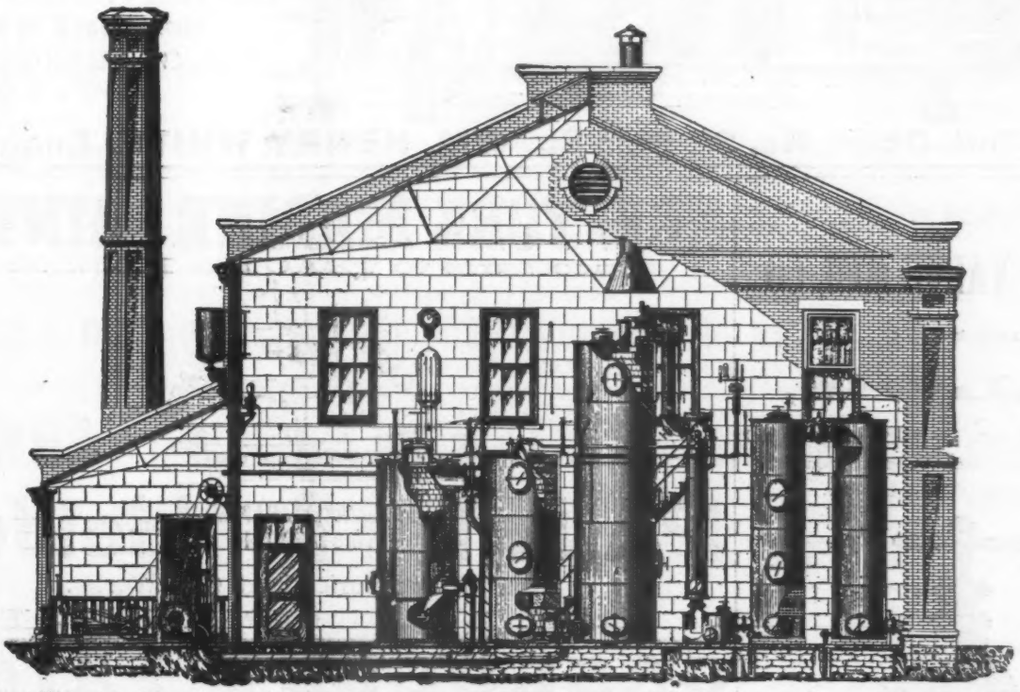

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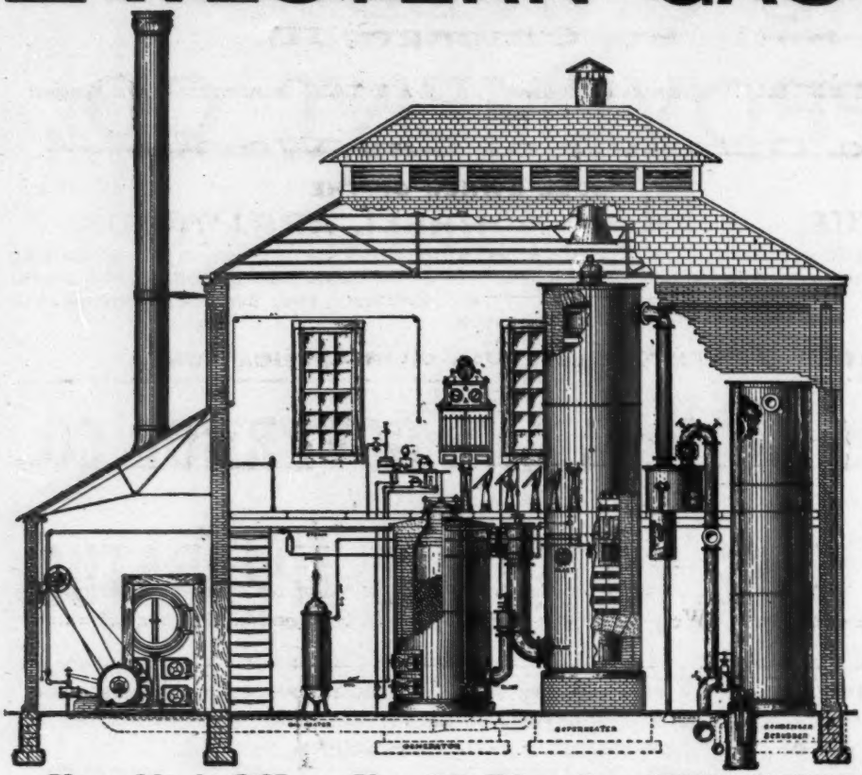

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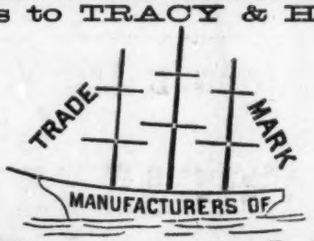

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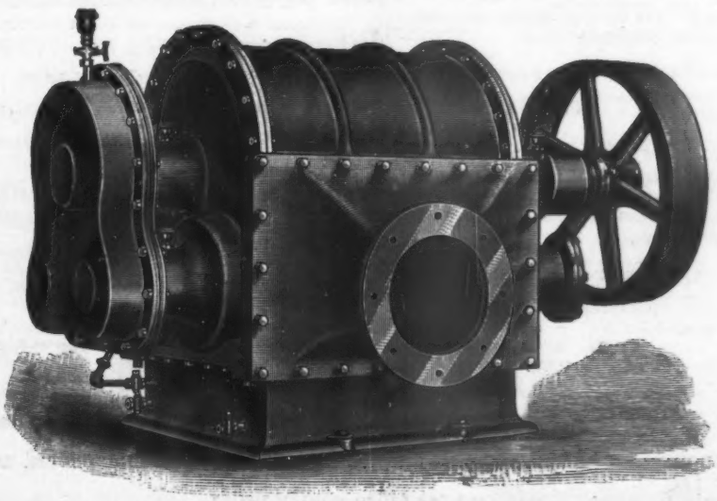

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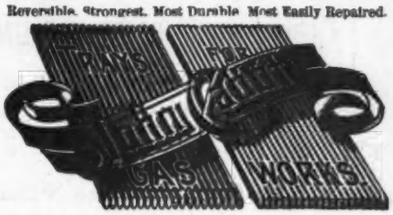

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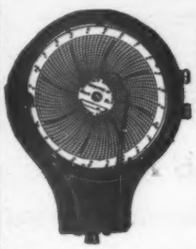

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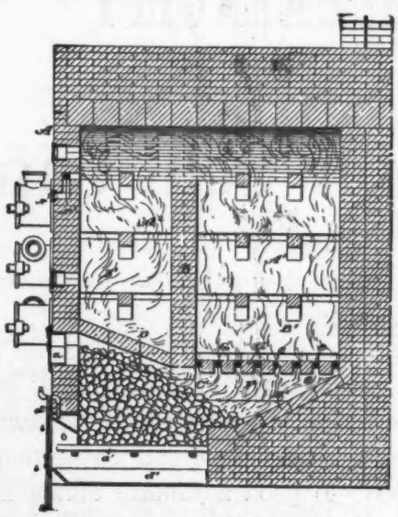

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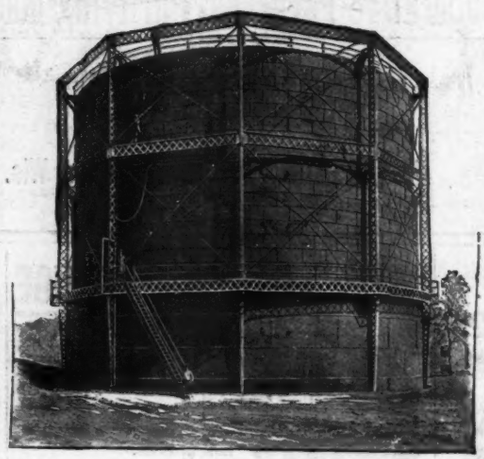

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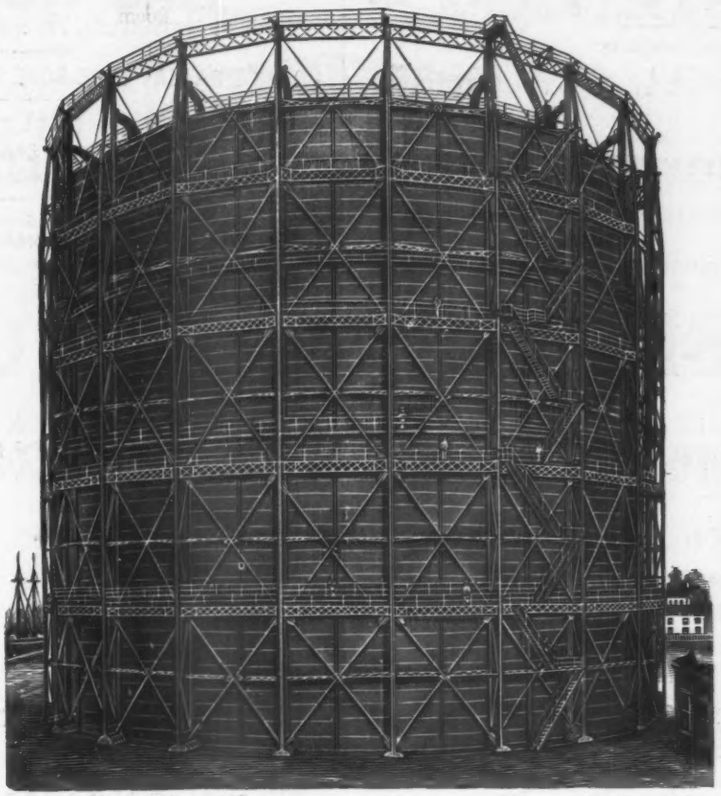

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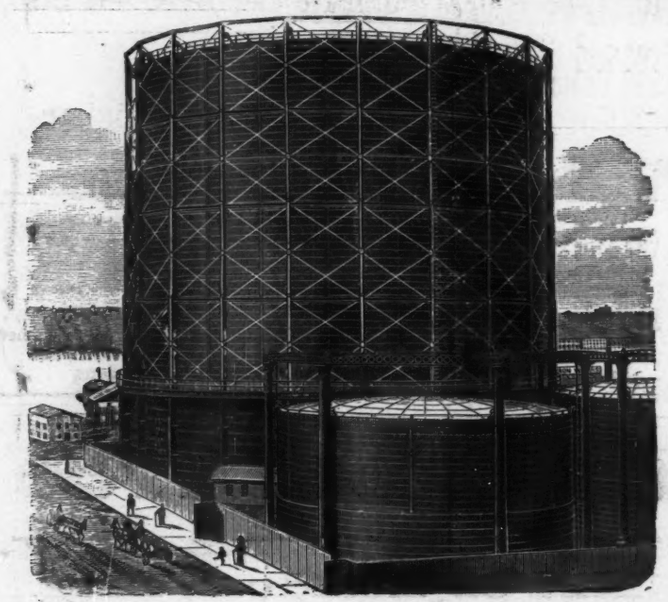

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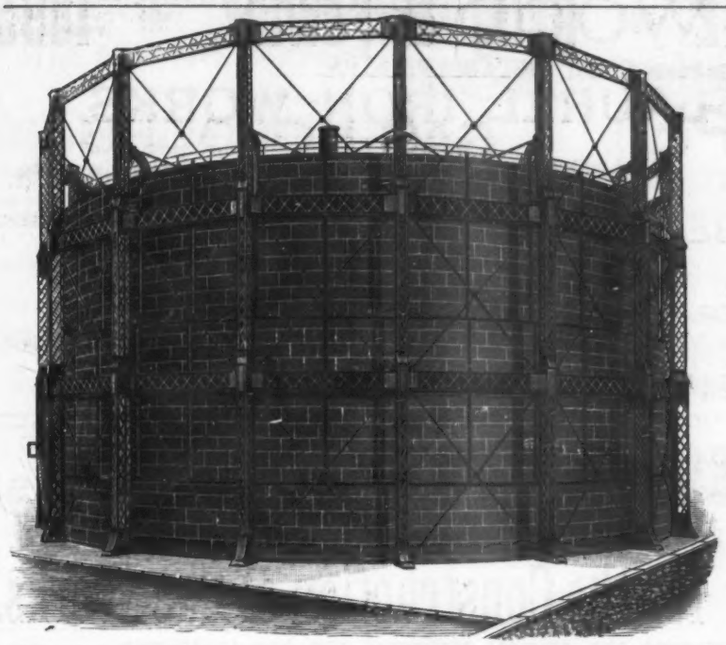

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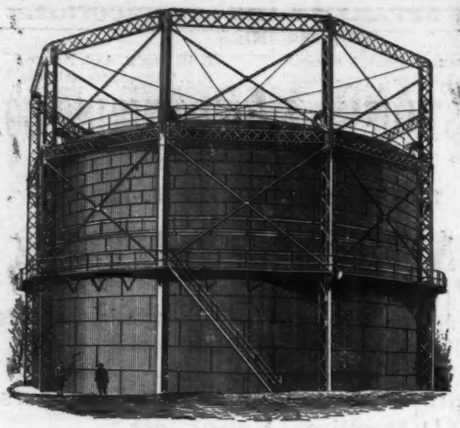

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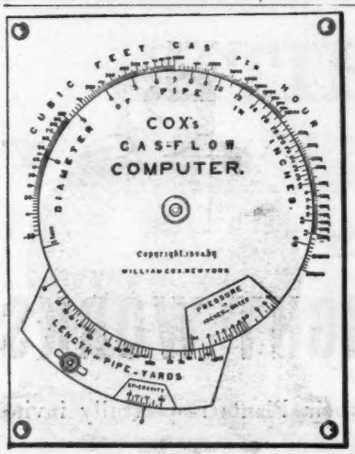

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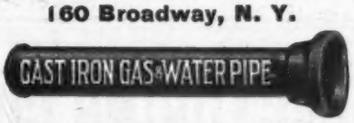

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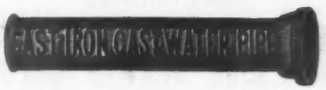

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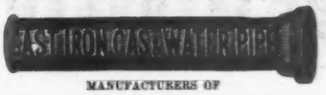

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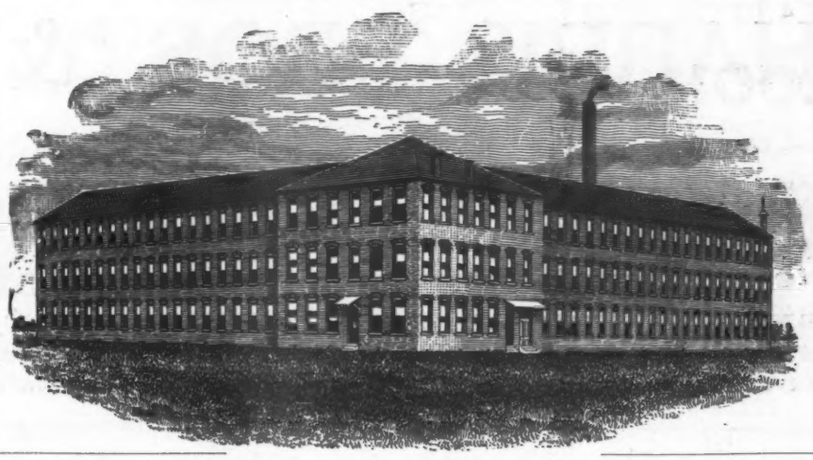

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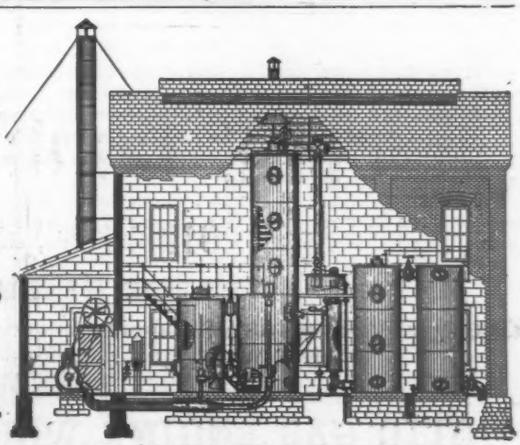

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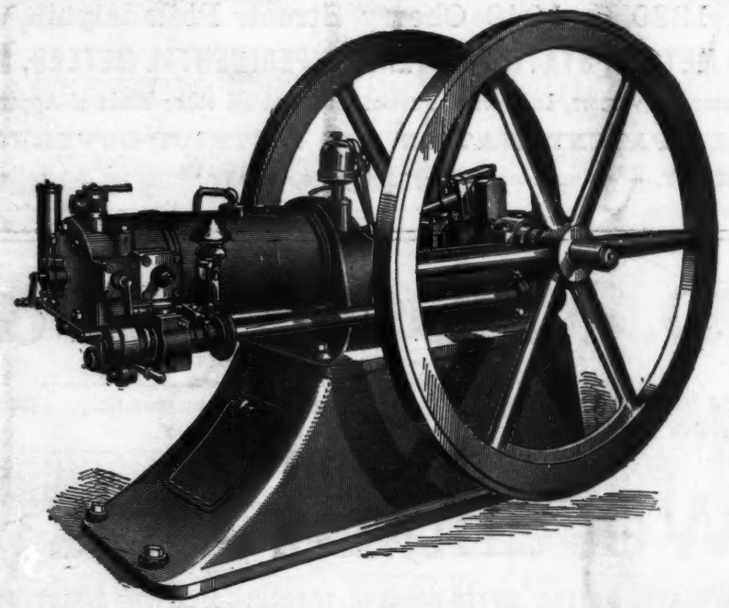

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